Iron Deficiency, Depression, and Other Affective Disorders in Female State Fair Attendees

A thesis submitted to the faculty of the University of Minnesota by

Kathleen Price

In partial fulfillment of the requirements for the degree of Master of Science

Faculty Adviser: Dr. Daniel Gallaher

Degree Conferral Date: May 2018

Abstract

Iron deficiency persists as the most prevalent nutrient deficiency on the planet, and women of menstruating age are at high risk due to menstrual blood loss. Recent data suggests that iron deficiency in the absence of anemia impacts quality of life, and currently the prevalence of menstruating females with inadequate ferritin values in the US is high. Although the literature on iron status and depression is conflicting, a relationship is suggested with a proposed mechanism of altered neurotransmitter functioning. This cross-sectional study gathered survey data and blood samples from 182 female subjects at the Minnesota State Fair in August of 2015. Whole blood hemoglobin, hematocrit, serum ferritin and serum TIBC were determined and correlated to survey data detailing reported iron deficiency symptoms and their severity, including the PHQ9, a validated depression screen. 15% of subjects were anemic as defined by a hematocrit value under 38% or a hemoglobin value below 12 g/dL. Additionally, 74% had low ferritin status as defined by a value less than 20 μg/L. Overall, 10% of subjects reported moderate to severe depression as defined by the PHQ9. Although independent relationships between anemia, low ferritin values, or elevated TIBC values and depression were not seen, inclusion of symptomatic iron deficiency, a variable combining iron deficiency symptoms of dizziness and shortness of breath to assess whether deficiency was exerting a physiological effect, improved the correlation between the biochemical measures of iron status and depression ($p < 0.0001$), as well as self-reported incidence of other affective and executive functioning disorders, including stress or

moodiness, ease of anger, emotional unresponsiveness, and alertness or concentration. This data suggests that iron deficiency must be symptomatic for the association with depression and other affective or executive functioning disorders to be apparent.

Table of Contents

Table of Tables

Table of Figures

Introduction

Iron's ability to transfer electrons makes it both a metabolic necessity and a homeostatic threat (1). The body sequesters virtually all iron to inhibit its oxidative consequences, and iron homeostasis is tightly regulated. The damaging effects of both iron deficiency and overload are well documented in the literature, and it persists as the most common nutrient deficiency on the planet and the only nutrient deficiency that is common in both developing and developed nations. Menstruating females are more likely to be iron deficient because of blood loss during menses. Much has been studied about iron deficiency and the developing brain, but many questions remain about how iron status impacts the fully developed brain. Measures of status, especially cutoff values, are highly debated.

The following thesis will examine multiple biochemical assessments of iron status and their correlation to documented iron deficiency symptoms in menstruating females. It begins with a review of relevant literature, and then details a cross-sectional study of iron status and reported symptoms.

Literature Review

Iron Metabolism

Iron Distribution

It has been estimated that under normal conditions the male human body contains about 3 g of iron, or about 40 mg iron per kg body weight (2). Due to menstrual losses, the estimate for females is slightly lower (1). The vast majority of body iron exists as hemoglobin in both circulating red blood cells (RBC) and in erythroid precursor cells in bone marrow, as individual erythrocytes require roughly one billion atoms of iron (1). An appreciable though varied amount also exists in storage in the liver and reticuloendothelial macrophages (2). Iron recycling by reticuloendothelial macrophages is critical to the maintenance of RBC, as their turnover requires daily usage of nearly 20 mg of iron, and generally only 2 mg are absorbed from diet each day (1). Additionally, iron exists in the muscles in the form of myoglobin, and less than 1% of body iron exists as part of cytochromes and metalloenzymes in various body cells.

Iron Absorption

Because the threat of oxidative stress from excess iron is severe and the body does not have a physiological mechanism to excrete surplus iron, iron absorption is tightly regulated. In foods, iron exists either as part of a heme complex or in the oxidized ferric state (3+) bound to other molecules (3). Absorption occurs near the gastro-duodenal junction through the villi of the small intestine where the low pH facilitates the disassociation of ferric iron from other molecules and presents it to the brush border in a

proton-rich mixture (4). The villi then absorb heme and non-heme iron by distinct mechanisms.

Little is known about heme iron absorption, though it is much more efficient and less influenced by other components of the meal than non-heme iron absorption (5). It is generally absorbed at a rate of about 25 to 30 percent of what is consumed (6). Heme iron generally refers to iron-protoporphyrin IX in all oxidation states and is a product of the breakdown of hemoglobin and myoglobin in the muscle tissue of animals (7). Evidence from multiple experiments on the enterocytes of various mammals indicates that heme iron binds the brush border of duodenal cells and enters the cells intact (8, 9). How heme makes this transition from the lumen to the intracellular space is still being elucidated. The theory that a saturable carrier protein facilitates this translocation was furthered by Noyer et al. in isolated rat hepatocytes and Grasbeck et al. in pig enterocytes (10, 11). Shayeghi et al. claimed to have isolated a heme protein carrier (HPC1) specific only for the heme molecule from mouse duodenum, but it was later noted that this transporter is also responsible for the absorption of folate (7, 12). It is currently believed that this carrier protein is responsible for the absorption of both heme iron and folate (13). Once inside the endosome within the enterocyte, heme oxygenase (HO) removes the ferrous iron from the heme molecule, which exits the endosome and joins the available iron mucosal pool (5).

More specific details have been revealed about the absorption of non-heme iron. First, ferric iron from both plant and animal sources must be reduced to the highly unstable ferrous (2+) state before entering the enterocyte (14). A ferrireductase called duodenal cytochrome b (Dcytb), a heme-containing protein, has been identified on the

brush border of the villi by isolation, genetic cloning, and immunostaining (14). It is highly expressed in the upper region of the villi and suppressed in the crypts, furthering the evidence that it is involved in iron transport, which occurs on the mature enterocytes on the tips of the villi (14). It has been demonstrated that it possesses ferrireductase activity through a study with oocytes that were microinjected with Dcytb cRNA, water, or a mock-injection. The oocytes injected with Dcytb cRNA possessed 5 times the ferrireductase activity than that of the controls (15). This reductase likely utilizes ascorbic acid for reducing power, and it is upregulated in both iron deficiency and hypoxia (5). Though an experiment with knockout (KO) mice who were able to efficiently absorb iron without Dcytb expression called its importance in inorganic iron absorption into question, it must be noted that mice may possess differing absorptive abilities, especially noting their ability to endogenously produce ascorbic acid (5, 16).

Once inorganic dietary iron has been reduced to the ferrous state, it is transported across the duodenal membrane by a transmembrane protein that transports numerous divalent cations, called divalent metal-ion transporter 1 (DMT1). The transport is powered by protons which likely come from the sodium/hydrogen exchanger (5). This transporter is believed to be imperative for non-heme iron uptake, as its mutation in humans results in iron deficiency (17). Once ferrous iron is inside the intestinal cell, it also joins the available iron mucosal pool and is furthermore indistinguishable from what was once heme iron.

This process of non-heme iron absorption is much less efficient than heme iron and is highly influenced by the other components of the meal. It is generally absorbed at a rate of 5 to 15 percent of what is consumed (6). Because it is humanity's main source

of iron, understanding the influences on non-heme iron bioavailability is central to understanding the global presence of iron deficiency. Even in the West where greater amounts of animal products are consumed, an estimated 85 percent of total iron consumed in the diet is non-heme (18). Various dietary components are known to enhance or inhibit its absorption.

One of the most studied enhancers of non-heme iron absorption is ascorbic acid. Evidence of its ability to enhance iron absorption in a single meal in controlled trials has been shown repeatedly. This effect is even more dramatic in the presence of an iron absorption inhibitor (19). Iron absorption in the presence of ascorbic acid appears to be constant if meat or fish are a component of the meal, but in the absence of meat or fish ascorbic acid greatly reduces the inhibiting effects of phytates and plant phenols, effectively enhancing iron absorption (20). The higher the phytate or phenolic content of the meal, the more ascorbic acid is needed to counteract its effects (21). It is believed to be either the reducing power, also utilized by Dcytb, that aids in absorption by presenting inorganic iron in the ferrous state to the villi, or the ability of ascorbic acid to form iron complexes that prevent it from bonding with other molecules (21). It has been argued that although ascorbic acid can increase iron absorption in a single meal, high intakes of ascorbic acid do not impact iron status over time. One such study on college students (n=17) supplemented two meals each day with 1 g of ascorbic acid for 16 weeks and found no change in serum ferritin levels (22). Hallberg has noted that because the diets of the students contained ample amounts of meat, it is possible that the diets already had a maximum capacity for iron absorption before the addition of the ascorbic acid; essentially, the meat masked the effect of the ascorbic acid (21). Another study on

female Irish nurses measured baseline ferritin values, and then supplemented the experimental group with 100 mg of ascorbic acid for 3 meals each day for 8 weeks and compared the changes in serum ferritin with a control group that did not receive ascorbic acid supplementation (23). Though the experimental group did see a greater increase in serum ferritin, it was not statistically significant. Hallberg again noted that serum ferritin may not be a valid measure for subtle changes in iron status, and it is not known whether any of the subjects were suffering from iron deficiency anemia. If so, additional iron would replete hemoglobin before being stored in ferritin. Further, 8 weeks may not have been sufficient time to see the effects on ferritin stores (21). While it is known that ascorbic acid does increase iron absorption in a single meal, its long term effect on iron status remains controversial.

Another lesser understood enhancer of non-heme iron absorption is present in meat and fish and known simply as meat factor. Layrisse was the first to note, using radiolabeled iron, that the consumption of meat with vegetables aided in the absorption of the non-heme iron found in the vegetables (24). Since that time, numerous attempts have been made to isolate the compound known as meat factor. A potential candidate was proposed by Armah et al. in a study that first isolated compounds through liquid chromatography from cooked beef that underwent a simulated digestion. It was then determined which compounds aided in iron absorption by their addition to a cell system using radioactive iron. The compound that had the highest ability to enhance iron absorption was identified by tandem mass spectrometry as L-α-glycerophosphatidylcholine. This compound was added to a food source and effectively enhanced iron absorption in a controlled human trial (25). Though this breakdown

product of lecithin is likely involved in the ability of meat and fish to enhance non-heme iron absorption, its mechanism of action is unknown, and whether other compounds in meat also facilitate non-heme iron absorption remains uncertain.

Alcohol other than red wine has also enhanced iron absorption in numerous controlled studies. It is thought that the additional secretion of hydrochloric acid by gastric cells accompanying the consumption of alcohol enhances iron absorption, but that the phenolic content of red wine counteracts this enhancing effect (26).

Conversely, a number of compounds are known to inhibit non-heme iron absorption, including polyphenols. Polyphenols contain an aromatic ring structure with hydroxyl groups attached. Hundreds of different types have been identified in foods (27). These compounds are likely involved in defending plants from various sources of oxidative stress, and they are widely studied for their potential role in lowering the incidence of chronic disease in humans. The exact mechanism by which they inhibit iron absorption is unknown, though their hydroxyl groups likely bind iron directly to form chelates (26). Some polyphenols, including tannic acid, have a strong, dose-dependent ability to inhibit iron absorption, while other polyphenols, such as chlorogenic acid, seem less effective; it has been suggested that the galloyl groups have the strongest ability to bind iron and thus account for this difference (28). It has been demonstrated that certain foods with a high polyphenolic content can reduce iron absorption up to 90 percent (29). Foods that are widely consumed in the West with an appreciable polyphenolic content include coffee, tea, red wine, and various spices such as oregano.

Another commonly consumed inhibitor of non-heme iron absorption is phytic acid. Phytic acid is comprised of six phosphates bound to inositol and is the storage form

of phosphate in plants. Like polyphenols, phytic acid likely chelates non-heme iron to make it unavailable for absorption. It was first noted in a classical study that bran possessed a strong inhibitory effect on iron absorption, and that finding has since been replicated numerous times (30). Controversy arose about which compound in the bran was responsible for this predictable effect, but Hallberg concluded that phytic acid is the principal contributor (30). In his research, bran was first washed with hydrochloric acid to remove the phytic acid content, but not with water, so other potential inhibitors would remain. This effectively eliminated inhibition, and when the phytic acid content of the bran was repleted, it again possessed the same inhibitory effect. Finally, the use of phytase to remove phytic acid content also increased the bioavailability of the iron within the bran. Therefore, Hallberg concluded that phytic acid likely chelates non-heme iron and prevents its absorption in the intestinal lumen (30). Foods that are widely consumed in the West that contain appreciable amounts of phytates include numerous whole grains and peanuts.

Calcium is an extremely controversial potential inhibitor iron absorption. Epidemiological data has correlated high calcium intakes to lower serum ferritin and hemoglobin levels, but controlled human trials continue to provide conflicting results (31, 32). Difficulty with replication has even been noted within the same research groups, as Cook et al. noted a significant effect in two studies but was unable to replicate that finding in a third (33-35). Unlike polyphenols and phytic acid, calcium supposedly impacts both heme and non-heme iron absorption (36). Because of this dual impact, some have suggested that it exerts its effect at a common step after the iron has translocated into the endothelial cell, potentially even impacting its release into the

bloodstream (37). It has also been suggested that calcium exerts its effect by competitive binding due to the unique dose response, as it appears that calcium has no inhibitory effect if the dose is less than 40 mg or greater than 300 mg (37). This sensitivity to dose may explain some of the conflicting results within the literature. At this point, with inconsistent findings from epidemiological studies, animal experiments, and controlled human trials, calcium's effect on iron absorption is uncertain.

Some evidence has suggested that consumption of both egg and soy can inhibit non-heme iron absorption. Though the research on the impact of egg consumption is extremely limited, it has produced consistent results (26). It has been suggested that the phospho-protein in egg yolk is responsible for the inhibition (38). Research is also limited on the impact of soy consumption, and some attribute its inhibitory effect to its high phytate content (26). Curiously, eliminating the phytic acid content in soy has produced mixed results on its inhibitory effects (39, 40). To date, it is unknown if other factors distinct from its phytate content cause soy to inhibit non-heme iron absorption. Because vegetarians who greatly decrease their consumption of heme iron and the absorption-promoting compound meat factor also tend to rely on egg and soy for protein, their possible inhibition of iron absorption may significantly impact this population.

Iron Transport, Uptake into Tissues, Storage, and Recycling

Once inside the epithelial cell, all absorbed iron exists in the ferrous state and comprises a common pool. The trafficking chaperones that direct iron within the enterocyte have not yet been determined, but it is clear that iron can either be utilized by the intestinal cell in the production of cytochromes and metalloenzymes, stored in ferritin

molecules within the cell, or exported out of the cellular basolateral membrane to enter portal circulation for use in other body tissues (5).

Ferroportin 1 (Fpn1) exports ferrous iron from inside the intestinal cell across the basolateral membrane into the bloodstream. Currently, Fpn1 is the only identified mammalian iron export protein, and it is critical to the metabolism of iron (5). Its expression is predictably increased in epithelial cells, macrophages, and hepatocytes where iron export is high. In a study where KO mice were unable to form Fpn1, severe anemia presented, furthering the evidence for the importance of Fpn1 in iron metabolism (41).

Because the plasma iron transport protein transferrin (Tf) binds iron in the ferric state, iron must be oxidized after exiting the intestinal cell. The liver produces a copper-containing ferrioxidase (FOX) protein called ceruloplasmin (CP) that circulates freely in the bloodstream and oxidizes ferrous iron for transport throughout the body, but tissues that frequently export iron also have distinct membrane-bound proteins that carry out this oxidation. Hephaestin (HEPH), with approximately 50 percent homology to ceruloplasmin, is this membrane-bound protein on the intestinal cells (5). The current understanding is that together, HEPH and CP oxidize ferrous iron to the ferric state for transport by transferrin after exiting the intestinal cell.

Because iron is extremely reactive, nearly all iron in plasma is bound to Tf for transport. Tf is produced and excreted by the liver and is generally only 30 percent saturated under normal conditions (1). Tf binds two iron molecules in the ferric state. Each of the two lobes of the Tf molecule, commonly denoted as the C and the N lobes, contain an identical iron ligand that contains tyrosine, histidine, and aspartate (42). It

appears that mammals that lack Tf are still able to survive, though they are severely anemic. This suggests that the production of RBC is extremely reliant on Tf, but other body tissues are able to absorb non-Tf iron by a mechanism that is not yet understood (43). Additionally, Tf is a negative acute phase reactant (APR), meaning the liver decreases its production during inflammation.

Once two ferric molecules have bound transferrin, it is taken up into various tissues via transferrin receptor 1 (TfR1). This transmembrane protein has a high affinity for diferric Tf and binds a single diferric Tf molecule before moving into a clatherin-coated pit for complete endocytosis. It is believed that iron binding to TfR1 leads to a conformational change in Tf that eventually allows it to release its ferric iron molecules (44). To further facilitate this release, H+ATPase pumps protons into the endosome to lower the pH to approximately 5.5. Tf, TfR1, and both ferric iron molecules disassociate in the acidic environment, and Tf and TfR1 are recycled back to the plasma membrane. Six-transmembrane epithelial antigen of prostate 3 (STEAP 3) likely oxidizes ferric iron to ferrous iron so that it can be transported across the endosomal membrane by DMT1 (3).

Intracellular iron has multiple fates. It can be shuttled to the mitochondria to synthesize heme structures or iron-sulfur clusters to meet the immediate protein needs of the cell, and intracellular iron homeostasis is maintained through iron response proteins (IRP) 1 and 2, which are discussed below. It has been suggested that the protein frataxin may be involved in transport into the mitochondria, as a mutation in this protein's gene, which presents as Friedreich's ataxia in humans, led to excess iron buildup inside the mitochondria of yeast (45). The identity of the cell determines which iron-containing

proteins are produced, as erythrocyte precursor cells produce hemoglobin, muscle cells produce myoglobin, and various other cells produce many other iron-containing proteins.

If the cell does not have an immediate need for iron, it is stored in a bulky protein called ferritin. In general, a ferritin molecule contains about 2000 iron atoms, though each ferritin has the capacity to store up to 4500 atoms (42). It is made up of both heavy (H) and light (L) subunits, and the ratio of H to L varies between tissue types. The iron likely enters the ferritin molecule by electrostatic gradients formed by the structure of ferritin (46). It is now understood that the H subunit oxidizes the ferrous iron to the ferric state, and it is incorporated into a crystal of ferrihydrite (47). No information is currently published on how iron is removed from ferritin and returned to the ferrous state, though it is known to occur to meet the organism's demand for iron (3). Trace amounts of ferritin exist in circulation, and this circulating amount is proportional to the total body ferritin of the organism (48). This proportionality is the basis for measuring serum ferritin to estimate iron storage. Additionally, ferritin is a positive APR, meaning that the liver increases its production during inflammation.

Finally, if the organism is in a state of iron overload, iron is also deposited in a compound called hemosiderin. Hemosiderin is likely a degradation product of ferritin, and it is contained in lysosomes, called siderosomes. It is a conglomerate of iron, protein, carbohydrates, and lipids (47). The greater the iron overload, the greater the concentration of hemosiderin, and it often deposits in the liver, pancreas, and lymph nodes. These deposits give the organs a rusty hue and can lead to cirrhosis, fibrosis, and eventual death of the organism.

As previously mentioned, most body iron is used to synthesize heme structures necessary for the production of RBC. As RBC age, they are consumed by macrophages and degraded. The macrophages then release ferrous iron into circulation via Fpn1, and GPI-ceruloplasmin, a membrane-bound protein with FOX activity, oxidizes it to the ferric state to bind Tf once more. This recycling mechanism is critical to the maintenance of body iron, as it is responsible for roughly 20 mg of iron binding Tf each day (1, 4).

Iron Regulation

It was previously mentioned that the regulation of non-heme iron absorption is of critical importance to body iron homeostasis as a physiological method of iron excretion does not exist. Consequently, the body possesses hormonal and posttranscriptional regulatory capacities to adapt to changing iron status.

In response to high iron status and inflammation, the liver synthesizes and secretes a small peptide hormone called hepcidin. Hepcidin moves freely in circulation to target Fpn1 on the membranes of various body cells and lead to its internalization and degradation (49). The binding of hepcidin to Fpn1 causes an intracellular tyrosine residue of Fpn1 to be rapidly phosphorylated. It is this phosphorylation that causes the internalization of Fpn1, where it is subsequently ubiquitinated. Ubiquitination signals Fpn1 to be transported into the lysosome, where it is degraded (50). The loss of Fpn1 from cell membranes prevents iron export, which is especially notable in enterocytes involved in iron absorption, macrophages involved in iron recycling, and hepatocytes with appreciable amounts of iron storage in ferritin. The iron then remains in the enterocytes until they are sloughed off of the intestine, preventing it from entering circulation, and in macrophages and hepatocytes, where it cannot bind Tf. The net effect

of increased hepcidin production is lowered iron in circulation (49). This impact has been further evidenced by the development of anemia in mice overexpressing hepcidin (51). It has also been suggested that hepcidin decreases iron absorption in the intestine through methods independent of its effect on Fpn1, and more details on hepcidin's impact on enterocytes is expected in the future (5).

Because hepcidin is also an acute phase protein, chronic inflammation can elevate hepcidin levels over the long term. This is believed to be the circumstance in the condition known as anemia of chronic disease, as the body likely withholds iron from the bloodstream to prevent infection at the expense of RBC production (1). As hepcidin degrades Fpn1 and prevents iron export, patients may present with low serum iron measures and even anemia while ferritin stores remain elevated (1).

Additionally, intracellular iron regulation is critical to the health of the cell, as excess iron is extremely reactive and can cause severe oxidation. Two distinct iron regulatory proteins (IRP), IRP1 and IRP2, impact intracellular iron concentration by posttranscriptional regulation. Both bind to a unique, hairpin structure called the iron response element (IRE) located in the noncoding region of either the 3' or 5' end of mRNA that code for proteins involved in iron or energy metabolism. Though both IRPs sense and respond to iron status differently, their binding to an IRE always indicates that intracellular iron concentration is low, prompting the cell to attain more iron (3). IRP binding to IRE is known to suppress the translation of H and L ferritin and Fpn1, preventing iron storage and export, and enhancing the translation of TfR1 and DMT1 by stabilizing their mRNA against degradation by RNAses, thereby promoting iron uptake into enterocytes and other tissues (52).

IRP1 senses iron directly, as changes in the intracellular iron concentration induce changes in the conformation of the protein. It has a high degree of homology to aconitase, the mitochondrial enzyme that isomerizes citrate to isocitrate in the TCA cycle (42). Importantly, both proteins contain an iron-sulfur cluster. When intracellular iron concentration is high, IRP1 assumes its aconitase conformation and has a low affinity for the IREs of various mRNAs. When intracellular iron concentration is low, the iron-sulfur structure spontaneously declusters, and IRP1 has a high affinity for the IREs of various mRNAs (53).

IRP2 regulation is likely more critical than IRP1 regulation. It senses iron indirectly through another cytosolic protein called F-box (FBXL5). When intracellular iron concentration is high, iron binds directly to FBXL5, which recruits an SCF complex to ubiquitinate IRP2 and lead to its eventual degradation in a lysosome. When intracellular iron concentration is low, iron does not bind FBXL5. This FBXL5 is then ubiquitinated and degraded in a lysosome (54). In this way, iron concentration actually changes the amount of IRP2 in the cytosol. Both IRPs assist in maintaining normal intracellular iron concentration.

Iron Loss

Iron loss in men is miniscule, but it is more pronounced in menstruating females and in certain disease states. Under normal conditions, it is estimated that the average man loses approximately 0.9 mg of iron each day, with 0.6 mg lost through the intestinal tract by the sloughing off of enterocytes, some gut blood loss, and bile; 0.2 mg sloughed off with skin cells; and 0.1 mg lost in urine (2). With the absorption of 1 to 2 mg of iron each day, adequate iron status in healthy males is easy to maintain, but the menstrual

cycle in females significantly contributes to loss of iron. The amount lost varies based on duration and intensity of menstrual flow, but it has been known to exceed absorptive capacity (2). Additionally, the third trimester of pregnancy also demands an amount of iron not likely to be absorbed from diet. In this way, iron is a unique nutrient in that some populations, notably females, may not be physiologically able to meet their needs through diet (2).

Additionally, any event that induces frequent or substantial blood loss will also contribute to loss of iron. Blood donation can severely impact iron stores, and can even shift an individual from an iron deficient state to anemia (55). Intestinal parasites that incur frequent gut blood loss also contribute significantly to the global incidence of anemia, with hookworm as a notable example (56-58). These complications contribute significantly to iron's status as a global health concern.

Biochemical Roles of Iron

Iron's ability to readily interconvert between its oxidized and reduced states allows it to play pivotal roles in human metabolism. Its main function is to assist with oxygen transport by serving as the metal cofactor in the heme structure found in hemoglobin and myoglobin. Over two-thirds of body iron exists in hemoglobin alone (1). Cytochromes, which are essential enzymes for energy metabolism and detoxification, also contain a heme structure and therefore contain iron. Cytochrome P-450s, a large family of enzymes involved in xenobiotic metabolism, and catalase are notable examples.

Some iron-containing enzymes do not contain a heme structure and instead bind iron through a sulfur atom. These iron-sulfur cluster proteins are abundant in the

mitochondria and are critical to energy metabolism. Two TCA cycle enzymes, succinic dehydrogenase and aconitase, are notable examples (3). Oxygen transport, energy metabolism, and detoxification are critical roles of iron in the body, and it can participate in these reactions as a cofactor.

Iron Overload

Because iron absorption is so tightly regulated and generally inefficient, iron overload from diet under normal conditions is rare. Some dietary practices, such as the frequent consumption of foods stored long-term in iron-containing vessels, can promote acute iron toxicity. This is believed to be the case in African Iron Overloading, where a traditional beer was brewed in non-galvanized containers, though a genetic factor may have also played a role (1). Additionally, acute iron poisoning was at one point the most common accidental childhood poisoning, though the incidence has declined in recent years (59). Iron and multivitamin supplement over ingestion is the most common cause of such events. Death by liver necrosis results from extreme acute iron toxicity.

Genetic mutations that result in iron loading are much more common. Most mutations impact hepcidin signaling and result in a lack of hepcidin production and subsequent unregulated iron absorption. Individuals who lack hepcidin production absorb 2 to 3 times more iron each day than the average person (4). Hereditary hemochromatosis (HH) is the most common of these mutations, and its classical form is a missense mutation that codes for tyrosine instead of cysteine on amino acid 282 of the HFE gene (4). HFE is a protein that forms a complex when iron concentration is high that eventually signals hepcidin production and release. However, the missense mutation

results in a loss of function of HFE. Classical HH is common among Caucasians, and it is estimated that 1 in 10 Americans possess one allele with this mutation (1). Symptoms present later in life and are more common in homozygous men, whose iron stores tend to be greater. They include fatigue, depression, hypergonadism, increased skin pigmentation, diabetes, and severe liver damage (4). Treatment is an altered diet that limits vitamin C and red meat as well as routine phlebotomy. Other, less common mutations result in lowered hepcidin production and increased iron absorption as well, including juvenile hemochromatosis (JH) and a mutation in TfR2.

Iron Deficiency

Incidence

Iron deficiency affects nearly 2 billion people globally, and it is among the most common risk factors for disability and death (60). In its most extreme presentation, it results in anemia, where the RBC count of the individual is markedly low, hindering oxygen transport. Anemia has a remarkable global presence, affecting approximately one third of the world's population (61). Though there are multiple causes for anemia, the World Health Organization (WHO) estimates that the most common cause for anemia on the planet is iron deficiency (61). Disparities in incidence are seen between different gender and age groups, as globally men between the ages of 15 and 60 have an anemia incidence of 12.7 percent, but non-pregnant women of the same age have an incidence of 29.0 percent. The highest incidence occurs in children under 5 years at 43 percent (62, 63). There are regional disparities as well; Asia and Latin America have a much higher incidence than the United States (61). It must also be noted that this data is flawed as almost all cases of anemia are reported as cases of iron deficiency (64). Nevertheless,

iron deficiency remains the most common nutrient deficiency on the planet, and it affects both developing and developed nations.

Although findings from the US indicate that iron deficiency is less prevalent than in many other nations, iron deficiency is still a pervasive national public health concern. A study that analyzed the National Health and Nutrition Examination Survey (NHANES) data from 2007-2010 indicated that US children 5 years of age and younger have an anemia incidence of 3.2 percent (65). This data is similar to previous findings from 2003-2006 NHANES data, indicating little improvement in this population between these years (66). The Center for Disease Control (CDC) stated that iron deficiency, instead of anemia, is likely the best way to assess iron status in the US (67). Cogswell et al. further analyzed NHANES data for non-pregnant women of childbearing age, another population of concern, to determine their incidence of iron deficiency by both total body iron and ferritin, which will be discussed in more detail below. Based on the body iron model, 9.25 percent of women were iron deficient, and the ferritin model indicated that 15.65 percent were deficient (66). Thus, iron deficiency continues to be a nutrient of concern for high risk populations in the United States.

Reasons for its prevalence in developed nations include a decrease in total energy intake with the decline of physical activity, higher consumption of refined foods that have a lower micronutrient content, or undiagnosed gastrointestinal disturbances (68, 69). Additionally, many diets may avoid important iron sources, such as red meat. Frequent blood donation is also an important contributor to iron deficiency, especially in vulnerable populations. Importantly, recent data has indicated that 70 percent of US donors have given blood in the past (70). Though donors are screened for anemia and

dismissed if hemoglobin (Hb) concentrations are too low, it has been argued that ferritin should also be considered in the best interest of the donor (55). Both of these biochemical measures will be discussed in greater detail below. For these reasons, iron deficiency in menstruating females remains pervasive.

Biochemical Measures of Iron Status

Though there is general agreement about how to assess anemia, great controversy exists over how to define and assess iron deficiency. A number of biochemical measurements exist, each indicating a certain stage in deficiency with a unique set of benefits and drawbacks. Cutoff values present a significant challenge, and more research is needed in their determination for many biochemical measurements.

Anemia is assessed through a complete blood count (CBC) to ultimately determine whether RBC production is low. As previously noted, this is the last stage of iron deficiency. Due to its cost and ease of determination, Hb concentration and hematocrit (Hct) are the most commonly used measures for anemia detection (67). Hemoglobin is a measure of the concentration of hemoglobin present in a whole blood sample, which is done spectrophometrically. Hematocrit denotes the percent of a whole blood sample that is RBC and utilizes a clinical centrifuge to separate RBC, while blood cells (WBC), and serum. Hb is more direct and sensitive than Hct and is effected sooner by low iron (67). For non-pregnant adult females, anemia is defined as a Hb value of 12 g/dL or less or a Hct value of 38 percent or less; a value below the cutoff for either test is sufficient for diagnosis (64). Mean corpuscular volume (MCV) and red blood cell distribution width (RBW) are more sensitive to the actual size of RBC and thus can be used to detect microcytic anemia, which is more specific to iron deficiency, but they are

much less common assessments. Additionally, because iron is needed in the production of heme from erythrocyte protoporphyrin, erythrocyte protophorphyrin concentration is also a method of anemia detection (67).

Iron deficiency is more difficult to assess, and each method remains controversial. It has been defined as minimal bone marrow iron stores, post iron supplementation improvement of Hb values by 1.0 g/dL, or unusual readings from a host of other biochemical assessments (67). As research continues to suggest an impact of iron deficiency on quality of life, defining this condition is imperative.

Ferritin is the most common biochemical measurement used to assess iron deficiency. In a recent review of different iron deficiency assessments, all selected studies utilized serum ferritin as part of the iron assessment (71). Serum ferritin is proportional to total body ferritin and thus a measurement of iron stores and a potential early indicator of iron deficiency; generally 1 μg/L of serum ferritin is equivalent to 10 mg of iron stored (72). In the same review, researchers noted inconsistencies in ferritin cutoff values. Some of this difference was due to characteristics of the populations of various studies; for instance, in patients with chronic kidney disease (CKD) a much higher ferritin cutoff value was used. Among recommendations for the general population, 4 studies recommended a cutoff of 12-15 μg/L, 3 recommended 25-30 μg/L, 2 recommended 45-50 μg/L, and a cutoff of 100 μg/L was also recommended in 2 studies to denote iron deficiency as "possible" (71). Disagreements in these cutoffs make comparisons across studies and extrapolation to larger populations difficult. The WHO generally agrees with the cutoff value of 20 μg/L for adult females (73).

Though the only known cause of low ferritin is iron deficiency, it is artificially elevated in inflammation, and can therefore incorrectly indicate sufficient iron status in depletion. Inflammation increases hepcidin production from the liver, so hepcidin in circulation is elevated. As it binds to Fpn1 and prevents iron export from various tissues, ferritin remains elevated while available iron is depleted (74). In addition, ferritin itself is a positive APR, and the liver increases its production during inflammation. To correct for the inflammatory response, some suggest measuring C-reactive protein (CRP), an inflammatory marker, but the exact concentration that indicates inflammation impacting ferritin is controversial. Additionally, serum ferritin remains elevated longer in the acute phase response than CRP, so α1-acid glycoprotein (AGP) has also been suggested as an inflammatory marker to adjust ferritin values, as it becomes elevated at a later stage and remains so for longer. Others have recommended the use of both (74). To date, ferritin adjustments remain controversial. Though a low ferritin value is always indicative of depleted iron, it is evident that serum ferritin values cannot be used in isolation to confidently assess iron status.

Because the liver produces more Tf in response to low available iron, its elevation is also an early indicator of iron deficiency. A number of methods use Tf to assess iron status, including total iron binding capacity (TIBC), a measure of total Tf in circulation, and Tf saturation (TSAT), which indicates the amount of Tf in circulation with iron actually bound. A TIBC cutoff of 400 μg/dL is generally observed, though this figure is debated (75). TIBC is lower in protein malnutrition and inflammation and elevated in pregnancy and with the use of oral contraceptives (76). TSAT utilizes this TIBC value in conjunction with a measure of serum iron. Serum iron alone, however, is unreliable due

to its immense variability (77). TSAT is calculated by dividing serum iron by TIBC and multiplying by 100 to obtain a percentage. In general, an adult with a TSAT value of 16% or less is considered iron deficient (78). Both TIBC and TSAT are less sensitive measures than ferritin as they are only impacted after iron stores are depleted (67).

A more recent test that has gained popularity measures serum transferrin receptor (sTfR). It was noted previously that TfR is upregulated when iron concentration is low. Some of these TfRs detach from the cell surface and can be detected in serum (79). This increase in sTfR is proportional to TfR on the surface of cells and thus can be used to determine iron status. Additionally, sTfR is not impacted by inflammation (80). The test is not widely available, and some researchers have found it be to less accurate than ferritin (81). More research is needed before the diagnostic value of this test can be determined.

Additionally, a sTfR-ferritin (sTfR-F) index has been suggested to estimate body iron. It is calculated by dividing sTfR by the log of ferritin. Though it was initially touted in the literature as an ideal iron measurement, accuracy of results have been extremely mixed (82). Additionally, the cost of performing both measurements has made this measurement potentially impractical for the majority of the population.

It is evident that one biochemical iron measurement in isolation cannot detail the iron status of an individual. The more information provided about the person, including age, gender, disease state, and smoking status, the more appropriate the interpretation of the chosen biochemical test will be. Ideally, multiple measurements can be obtained to provide a detailed image of the state of iron status. The biochemical measures of iron deficiency and their cutoff values require further research.

Symptoms

Signs and symptoms of iron deficiency and iron deficiency anemia (IDA) are still under fervent study. As previously noted, under normal conditions ferritin levels initially fall, followed by a decrease in serum iron and increases in Tf and TfR1. Hemoglobin in whole blood eventually declines, with a concomitant rise in erythrocyte protoporphyrin levels, and finally hematocrit values decrease. In IDA, RBCs first become microcytic and then hypochromic. The physiological manifestations of this process and the stage in which they occur is still under investigation.

Classic

There are numerous reported and generally accepted physical signs of IDA. The most common is paleness, especially noting a change in previous color tone (64). Because cells with rapid turnover are more sensitive to iron depletion, dryness is noted in both skin and hair, and some develop koilonychia, or a spooning structure of the nails. A rough appearance of the tongue is also noted, and this sign can denote length of iron insult (64). Alopecia due to iron deficiency has also been documented; population correlation studies have produced mixed results, but animal studies have suggested that a maternal iron deficient diet can produce pups with alopecia (83-85).

The most classic symptom of iron deficiency is fatigue, due likely to hypoxic conditions from the lack of RBCs or low iron's impact on the TCA cycle in mitochondria. Fatigue is generally defined as "a persistent, overwhelming sense of tiredness, weakness or exhaustion resulting in a decreased capacity for physical and/or mental work" (86). Unfortunately, fatigue is both an occasional condition of healthy individuals as well as a symptom of a number of acute and chronic diseases. Due to its

commonality and subjectivity, some medical professionals deemed this nondescript term inappropriate for specific diagnosis nearly a century ago (87). Additionally, due to its elusiveness, assessment tools for fatigue are numerous and not well researched. A recent review noted over 250 fatigue measurements in published literature, and many are specific for certain disease states (88). Nevertheless, the term has endured, as it has extreme pervasiveness in iron deficiency and can have debilitating consequences on quality of life (QOL). It has also been noted that patients with chronic disease report experiencing fatigue in a fashion distinct from their previously healthy state, which suggests it can be assessed separately from routine fatigue felt in healthy individuals (89). A nonspecific, comprehensive fatigue assessment tool is needed to assess differences between healthy individuals and those in various disease states (87). Despite these issues, fatigue remains perhaps the most important indicator of iron deficiency. The first clinical trial to report a significant decrease in fatigue in non-anemic iron deficient women after treatment with supplemental iron as compared to a control was seen over 50 years ago (90). These findings have since been replicated. A 2003 randomized double blind placebo controlled clinical trial on 144 non-anemic women aged 18 to 55 who saw a physician with fatigue as their principle complaint found a significant decrease in fatigue in the treatment group, which received 80 mg/day of elemental iron by ferrous sulfate for four weeks, as compared to the group that ingested a placebo for four weeks. Fifty-one percent of women had serum ferritin values at 20 μg/L or below, and the treatment and control groups were matched equally for baseline ferritin, Hb, age, fatigue, depression and anxiety. Fatigue was assessed at baseline and after the intervention by a ten-point scale where patients self-reported their perceived status. In this short trial, only

women with ferritin values at 50 μg/L or below improved their fatigue score, and the effect was significantly greater than that of the control group (91). Fatigue remains the principal symptom associated with iron deficiency, even in the absence of anemia.

In relation to fatigue, exercise endurance also has a well-documented relationship with iron status. IDA has a strong repressive effect on exercise endurance (92). Curiously, long-term strenuous exercise has been suggested to cause IDA, though the biological mechanism has not been elucidated and the research is inconsistent (93-96). Iron deficiency in the absence of anemia is less researched, but some data suggests it can also impair aerobic performance (97).

Other documented symptoms likely caused by hypoxia include breathlessness both at rest and during exercise, dizziness, fainting spells, vertigo, headache, and heart murmurs (64). It is suggested that heart palpitations are felt as the circulatory system attempts to compensate for lack of RBC, and angina may also occur during exercise due to lack of oxygen to support need (98). Another more elusive symptom is pica, or the urge to consume non-food items (99). This behavior has manifested as frequent ice chewing or consuming dirt, laundry detergent, or other non-nutritive substances. This behavior as it relates to iron deficiency warrants further research, but each has been noted throughout the literature.

Cognitive

It is well known that iron deficiency can impair cognitive development in the developing brain, but its impact on developed, adult cognition is still uncertain. It is the

cerebral impact in combination with its pervasiveness that distinguishes iron as a global nutrient of concern.

It is estimated that 200 million children under 5 in developing nations are unable to develop their full cognitive abilities due to a number of risk factors, and iron deficiency is a notable factor (100, 101). Because iron status is universally lowest in late pregnancy and infancy, iron and cognitive development in children remains a concern. Reported impacts involve memory, attention, concentration, behavior, and motor skills (102, 103). Current evidence indicates that a critical window exists where iron is crucial to neurological development, and cognitive impairment cannot be overcome if deficiency exists during this time. The exact age of this critical window has not been elucidated, but it is estimated to be any time before 3 years. It appears that cognitive impairments due to iron deficiency can be corrected through supplementation if the iron insult occurs after this critical window (104, 105).

When attempting to elucidate the biochemical mechanisms for altered cognitive development in children, most attention has been given to the hippocampus. This cerebral region is of interest because it has a higher iron concentration than other brain regions and undergoes rapid growth at the time that appears to be the critical window for permanent impairment, and thus is the most sensitive to iron deficiency at this time (102). Higher concentrations of brain iron are also found in the nucleus accumbens, the red nucleus, the deep cerebella nuclei, and the substantia nigra, with the iron concentration in those regions varying depending on the stage of development (106-108). Numerous animal studies have demonstrated altered neural structures, impaired myelination, abnormal energy metabolism, and changes in neurotransmitters during iron deficiency

(109). Specific attention has been given to altered dopamine metabolism, which is responsible for numerous goal-oriented behaviors (110). Some speculate that because the brain regions that involve γ-aminobutyric acid (GABA) signaling correlate with the brain regions high in iron, altered GABA functioning may be involved in the impairment of cognition in iron deficiency, but research in this area is limited (111). Additional research has indicated that iron deficiency without anemia in children can cause cognitive impairments that are corrected with supplementation. Two recent reviews detail the impact of low iron on the brain as well as the state of research and questions still to be addressed on cognitive impairment in children (102, 111).

Due to the population examined in my study, more attention will be given to the impact of iron deficiency and IDA on the adult brain, with a focus on menstruating females. As previously noted, this population is particularly vulnerable due to iron loss in menstruation and pregnancy. NHANES data has suggested iron deficiency occurs in 15 percent of women between the ages of 20-49 in the United States (66). Myelination is likely secured at this point in development, and it is postulated that brain energy metabolism is highly conserved, so much attention has been given to altered neurotransmitter metabolism. Upon the discovery that iron deficiency without anemia can impact cognition in children, and that low ferritin is common in the adult female population, research interest in this area has grown. To date, however, only a few published studies exist addressing the question of cognition and iron deficiency in this population. A 2013 review found only 10 studies that met their search criteria; 7 were randomized controlled trials, 2 were controlled trials that were not randomized, and 1 was a cohort study. Drawing conclusions across these studies is difficult due to differences in

measures of iron status, assessments of cognitive functioning, and the length and dosage of iron treatment. Ultimately, this review emphasized the need for standardization and could not draw any definitive conclusions, but the current evidence does suggest a link between iron deficiency and impaired cognitive functioning in women of menstruating age (73).

Cognition can be separated into either executive functioning (EF) tests or mental health tests. EF involves the pursuit of goals and includes a variety of mental tasks such as planning and memory. Altered EF abilities may be related to disturbances in dopamine signaling (109). Mental health is closely tied to fatigue, a previously mentioned symptom, but also includes affective characteristics such as anxiety, depression, and mood (111). Neurotransmitter signaling is again highly involved in these processes.

Results from both randomized controlled trials and cross sectional studies on iron status and EF capabilities have been mixed. Again, the biochemical assessments of iron status, assessment tools used for cognitive functioning, and length and dose of iron treatment have varied, and these differences likely account for much of the discordant outcomes. While some studies focused only on IDA, more current studies have focused on iron deficiency in the absence of anemia.

A 2013 cross sectional study included 42 non-anemic UC Davis undergraduate females aged 19-30 that were screened for inflammation, pregnancy, and a number of other confounding variables. Serum ferritin, serum iron, and sTfR were measured to calculate body iron, which was the principal iron status assessment. After samples were collected and a standardized snack was consumed to account for cognitive impairment

due to fasting, subjects participated in a number of verified cognitive tests designed to assess planning, memory, attention, reaction time, verbal memory, and motility. The Tower of London (TOL) test, included to assess planning and memory, was the only cognitive test that was significantly lower in those with low iron status. Particularly, a longer planning time on the more difficult tasks was significantly associated with lower body iron and ferritin. Curiously, the TOL test was the only test given manually while all other assessments were taken electronically. Though the authors do not mention how this could confound results, it may shed more light on how iron deficiency exerts its impact on cognition. Ultimately, this study reveals a correlation between iron deficiency without anemia in adult females and lowered performance on certain aspects of EF, particularly planning time, but not other EF capabilities (112).

Another cross sectional study published in 2016 also aimed to determine which aspects of EF are impacted by iron deficiency without anemia in this population. Iron status measures and cognitive assessment were determined on 127 non-pregnant, non-anemic female subjects between the ages of 18-35. Iron status measures included Hb, RBW, serum iron, TIBC, ferritin, sTfR, and AGP, with both TSAT and total body iron calculated from these results. The researchers then categorized the participants as iron deficient or iron sufficient, based on body iron as well as 2 or more unusual readings from ferritin, sTfR, TSAT, or RBW. Because this study examined such a multitude of iron status values, it was likely more sensitive to subtle changes in iron status. All verified cognitive assessments were given electronically, and they were designed to assess attention, learning, inhibitory control, memory, and planning. One of these tests was again the TOL assessment, which again showed a significant association between

planning time and iron status; higher ferritin was significantly related to faster planning time. These results suggest that the manual presentation of the TOL test in the previous study did not impact the outcome. Additionally, higher ferritin and total body iron significantly decreased planning time when moving from easier to more difficult tasks. These results support the work in the previously mentioned study. Curiously, however, when working memory was assessed using the Sternberg memory search (SMS) task, both increased ferritin and total body iron stores worsened time and performance (109). This thorough assessment of iron status and breakdown of cognitive tests sheds further light on which aspects of EF are impacted by iron and at what stage of deficiency. The finding that some aspects of cognition may be improved while others are worsened by increasing iron status may account for differing results on iron and cognition. Additionally, the correlation between lengthened planning time and poor iron status in adult females has been replicated.

Despite these examples of cross sectional studies that revealed associations between iron status and EF, a number of randomized controlled trials that tested iron status and EF both at baseline and after iron treatment found no difference in EF despite baseline differences in iron status. Curiously, despite the lack of baseline difference, these studies note a significant change in EF after iron treatment.

One such trial looked specifically at the association of anemia with EF in 81 South African mothers during the postpartum period from 10 weeks to 9 months after giving birth. The mothers were split into three groups based on iron status and treatment: non-anemic controls matched for socioeconomic status, age, and education; anemic mothers given a placebo; and anemic mothers given 125 mg of iron sulfate each day.

Iron status, EF, depression and stress were evaluated at both baseline (6 weeks after giving birth) and study conclusion (9 months after giving birth). EF was assessed by the Raven's Colored Progressive Matrices test and the Digit Symbol test, as well as mental health measures that will be discussed below. At 9 months, the treatment group had significantly greater Hb, TSAT, and ferritin values. The placebo group also had significantly increased in Hb values, but this likely reflects correction of iron status over time after giving birth, and a greater number of women in the placebo group were still anemic compared to the treatment group. Although no difference was seen at baseline, the treatment group significantly increased in scores of both cognitive assessments, while the placebo group showed no significant change. The researchers suggest that perhaps the baseline difference is masked by many other confounding variables that could be present directly after birth (113).

Another randomized controlled trial that did not note a significant difference in EF at baseline between iron status groups but did note significant improvement after treatment was a 2014 pilot study designed to test the appropriateness of the IntegNeuro cognitive assessment tool on adult females. This trial included only female participants between the ages of 18-35 with a Hb value greater than 12 g/dL to exclude anemia, and then split the women into two groups based on their ferritin status; women with ferritin greater than 20 ng/mL were classified as iron sufficient while women with ferritin values less than 20 ng/mL were classified as iron deficient without anemia. The 24 women in the iron deficient group were assigned to receive either a placebo, 60 mg of elemental iron or 80 mg of elemental iron each day for 16 weeks. The 8 iron sufficient women received a placebo. Iron status measures were determined and cognitive performance

was assessed at baseline and again after 16 weeks. When the data were analyzed by ferritin improvers verses non-improvers, the ferritin improvers had a significant increase in their scores of impulsivity and attention (103). The sample size of this study was small, but it follows trends noted in other studies.

In contrast to the studies discussed above, a number of randomized controlled trials have noted both a difference in EF at baseline based on iron status and a significant improvement in iron treatment groups. The most well-known of these is a 2007 trial done by Murray-Kolb and Beard on healthy, non-pregnant women between the ages of 18-35. Initial iron status measures included Hb, Hct, ferritin, sTfR, serum iron, TIBC, and CRP, and both TSAT and total body iron were calculated from these results. The women were then classified as iron sufficient, iron deficient without anemia based on Hb measure above 12 g/dL and 2 or more other unusual iron readings, and iron deficiency anemia based on Hb measure of 12 g/dL or less and 2 or more other unusual iron readings. After this classification, the women were randomly assigned either to a treatment group that received 60 mg elemental iron each day for 16 weeks or a placebo group. EF, specifically attention, memory, and learning, was assessed by the Cognitive Abilities Test (CAT) at baseline and after 16 weeks. At baseline, women in the control group performed significantly more accurately and quickly on the CAT test than those in the anemic group. The iron deficient without anemia group performed in between these other groups, which followed the trend but did not reach statistical significance. After treatment, those that improved in serum ferritin improved in cognitive performance, and those that improved in Hb improved in cognitive speed (114). It may be that a significant difference was not seen in cognitive abilities between the non-anemic group and the

group that was iron deficient without anemia because the cognitive assessment was not specific enough to detect this difference. Other human trials have yielded similar results, where EF was negatively correlated with iron status at baseline and improved with iron treatment (115, 116).

Some trials have included only iron deficient subjects and thus do not contain a baseline comparison between iron deficient and iron sufficient groups. A 1996 study of females ages 13-18 looked only at non-anemic iron deficient females, while a 1970 study focused on only IDA female subjects aged 20 and older (117, 118). Both involved random assignment to a treatment group or placebo group, and both only treated subjects for 8 weeks. The study that involved non-anemic patients found some significant improvement on EF tasks in the treatment group, while the study that recruited only anemic patients did not. The latter only accepted patients with Hb values lower than 10.5 g/dL, and almost half of the treatment group participants did not replenish their hemoglobin by 2.0 g/dL after treatment. It is likely that iron replenishment in the brain, especially for severely anemic subjects, takes longer than 8 weeks to recover, and may only occur after RBCs recover. The discordant results between these two studies are likely a difference in the severity of iron depletion and an insufficient treatment time, resulting in incomplete repletion. Results from a 1986 trial by Groner was not included because all participants were pregnant at the time, and results from a 1998 trial by Kretch was not included because all participants were on a calorie restricted diet (119, 120). Though often cited in the literature, these studies contain significant confounders.

Overall, it appears that iron deficiency, including in the absence of anemia, has an impact on certain aspects of EF in women of reproductive age. Some tasks are improved

with iron repletion while there is evidence to suggest working memory may be impaired. The biochemical assessments of iron status, assessments of EF, and length and dose of iron treatment would benefit from standardization to facilitate comparison among studies. Further, additional studies of the biological mechanisms behind the effect are warranted.

The current state of the literature on the connection between mental health and iron status is further muddled by subjective, self-reported assessments and a lack of randomized controlled trials, but the evidence certainly suggests an association. Affective characteristics studied in relation to iron deficiency include irritability, anger, or mood; depression, both as postpartum depression (PPD) or depression independently; and perceived QOL. Differences in assessment tools as well as length and dosage of iron treatment likely play a pivotal role in discordant results. Most studies also include fatigue as a primary outcome as it is closely tied to these affective characteristics.

Irritability, anger, and mood instability have briefly been addressed in relation to iron status in both observational and intervention trials. A 2014 Japanese cross sectional study categorized 76 female subjects aged 18 to 22 as either iron sufficient, iron deficient without anemia, or IDA based on Hb and ferritin concentrations. The study utilized the Japanese version of the Cornell Health Questionnaire (CMI-J) to assess mood instability. Curiously, no significant difference was noted between iron sufficient subjects and IDA, but non-anemic iron deficient subjects showed a significantly higher incidence of fatigue, anger, tension, and neurotic tendencies than iron sufficient subjects. The researchers suggested that perhaps Hb concentrations in the IDA were not low enough to see an effect, with an average of 11 g/dL. Nevertheless, an association between mood instability and lowered ferritin concentrations in the absence of anemia was noted (121). Clinical

trials, however, have yielded inconsistent results. The 1970 trial by Elwood discussed in relation to EF also included a self-assessment of irritability and did not note any significant improvement after 8 weeks of treatment. As noted previously, the trial included only severely anemic subjects, and nearly half of the treatment group remained anemic at the trial's end (118). This severely deficient iron state likely confounded the results. Additionally, a 1988 intervention trial looked specifically at iron deficiency in female athletes at the university level and was unable to note improvement in mood with improved iron status. The study lacked a true control, as it compared 100 athletes to other female university volunteers that did not exercise more than 3 hours each week. All athletes that were iron deficient were given 325 mg of ferrous sulfate while all other participants received a placebo. Using the Profile of Mood States (POMS) assessment, no difference in emotional instability was seen between groups (122). Conversely, other intervention trials have noted improvement in mood with improved iron status. A 2009 trial looked specifically at women involved in an 8-week military basic combat training (BCT). Also using the POMS assessment tool, a significant improvement was noted in those supplemented with 100 mg of ferrous sulfate as compared to the placebo (123). More standardized trials declaring mood as the primary outcome are needed for conclusive evidence, but an association from observational studies as well as results from controlled trials indicate a possible relationship between mood and iron deficiency.

Depression and iron status have also yielded similar mixed results, but with an overall trend toward an association. Among women of childbearing age, both PPD and depression are common, and both have been studied in terms of iron status.

The evidence for a relationship between PPD and iron status is strong. Multiple observational studies have noted a correlation, and intervention trials have noted a significant decrease in incidence with iron treatment. A 2003 observational study measured the Hb values of 37 women at 7, 14, and 28 days after giving birth and then assessed depression on day 28 by the Center for Epidemiological Studies Depressive Symptomatology Scale (CES-D). Under normal conditions, Hb values generally recover by 7 days after giving birth. Using the data from day 7, a significant negative correlation was found between Hb status and depression scores, as well as between the mean Hb value from days 7, 14, and 28 and depression score. Though the sample size was small, the researchers noted that those who did not recover Hb by the seventh day after giving birth were more likely to experience PPD (124). Another larger observational study in 2011 examined iron status 48 hours after birth in 729 Spanish women over 18. CRP was also measured to exclude an extreme inflammatory effect. Forty-eight hours was chosen because the women were likely to rebound from many biochemical effects of childbirth but were still located in the hospital. Depression was assessed at 48 hours, 8 weeks, and 32 weeks after birth by the Edinburgh Postnatal Depression Scale (EPDS), and confirmation of PPD diagnosis was done by the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV criteria for PPD, called the Diagnostic Interview for Genetics Studies (DIGS). Using a ferritin cutoff of 12 μg/L, likelihood of PPD significantly increased in iron deficiency (125). Additionally, a well-known intervention trial in 2005 examined PPD and stress in 81 South African women from 10 weeks to 9 months after giving birth. Anemic mothers received either a placebo or an iron supplement, while a control group that was not anemic also received the placebo. Also

utilizing the EPDS, a significant decrease in PPD symptoms was noted in women who received the treatment verses the placebo. Analysis of stress was inconclusive, as stress increased over time for all new mothers (113). Ultimately, because childbirth results in a great depletion of body iron, a logical link between iron status and PPD exists, and treatment of PPD with iron is extremely accessible and affordable.

At this point, most of the research on depression and iron status has been observational, and results have been inconsistent. A 2003 observational study used French female subjects aged 35-60 from the "Supplementation en vitamines et mineraux antioxydants" (SU.VI.MAX) study, which assessed the impact of various vitamin and mineral supplementation on premature death, especially by cancer and cardiovascular disease (126). Any postmenopausal women or women with ferritin values over 80 μg/L were excluded under the assumption of underlying inflammation. The study assessed ferritin values at baseline and then after two years. The researchers found that the best mental health score from the DUKE health profile, a validated 17-question assessment designed to determine self-reported health status, came from the iron depleted women, but the results did not reach statistical significance. The questionnaire was not administered at the time of either blood draw, and was instead given in the years between them (68). Because iron status can fluctuate, especially in this population, this type of analysis may not have been appropriate. Another observational study in Japan utilized the CES-D scale cross-sectionally with iron measures in 312 men and 216 women. Curiously, an association was seen between low iron and depression incidence in men but not in women. Because the incidence of iron deficiency was not noted in the study, perhaps it was too small for an effect to be seen in females. Additionally, there was no

mention of a correction for inflammation (127). Some observational studies on women have seen a positive correlation between depression incidence and low iron status. A 2007 Iranian study on 192 female medical students between the ages of 20 and 30 investigated this association. Blood samples were analyzed for Hb, ferritin, CRP, folic acid, and vitamin B12, and results from a questionnaire based on the Beck Depression score. Anemic subjects were excluded and a ferritin cutoff of 15 μg/L was utilized for iron deficiency. It was noted that the mean ferritin value in the depressed students was significantly lower than in those who did not present with depression, and the incidence of iron deficiency was 15% higher in the depressed students (128). Overall, the evidence from observational studies supports an association between low iron status and depression.

Another affective characteristic that has been examined in relation to iron status is QOL. In a 2006 intervention study that lacked a true control, 92 Japanese non-pregnant, menstruating females with IDA were assessed at baseline for the Medical Outcome Study, and then provided with 100 mg of sodium ferrous citrate. The subjects took the same questionnaire again after 1 and 3 months of treatment, and their scores were compared to Japanese national averages for their age bracket. Hb did increase over treatment, and the final mean was 13 g/dL. At baseline, IDA women scored significantly lower in self-reported vitality and general health. After 1 month, only emotional status lagged behind national averages, and by 3 months, the women had improved in all sections of the questionnaire, and were either identical or exceeded national averages. Additionally, those with lower Hb values at baseline improved more dramatically (129). This study clearly supports a link between perceived health status and iron status.

Ultimately, iron status and cognition, both in terms of EF and affective characteristics, are deserving of additional randomized controlled trials to further analyze their relationship. Impaired cognition at any phase of life is detrimental to self-actualization and happiness, and can negatively impact occupational output. Iron supplementation represents an inexpensive and non-invasive treatment that could have large societal impacts.

Other

A number of other symptoms have been investigated in relation to iron status. Impairment of thyroid function in iron deficiency has been noted in both animal and human studies. Iodine deficiency and iron deficiency coexist in many parts of the world, and concern has been raised about whether poor iron status has prevented the effectiveness of iodized salt (130). This concern has prompted much research in this area. Impaired thermoregulation, a symptom that is often seen in IDA, has been studied in relation to impaired thyroid function. It has been noted that after an exposure to cold, iron sufficient rats have a more significant spike in triiodothyronine (T3) and thyroxine (T4) than rats with IDA (131, 132). Human studies have revealed similar findings; one study found that though iron sufficient and iron deficient women had similar plasma concentrations of T3, T4, and thyroid stimulating hormone (TSH) at room temperature, the concentrations were significantly reduced in iron deficient women after exposure to cold temperatures (133). The biological mechanism that links thyroid function to iron deficiency is still under study, but attention has been given to thyroid peroxidase (TPO), a heme-containing enzyme that is critical to thyroid metabolism. A review of animal and

human studies, proposed mechanisms, and future directions for thyroid function and iron deficiency is provided by Zimmerman (130).

It has also been suggested that low iron may play a role in the development of asthma. To date, the biological mechanism is unknown, but animal models have suggested a link. One study demonstrated that an iron deficient diet produced marked asthma in mice used to test allergic asthma, and that subsequent iron supplementation decreased lung inflammation (134). Building on this study, a 2015 study used 2007 through 2010 NHANES data to test for associations with ferritin, sTfR, and body iron to asthma, lung function, and pulmonary inflammation in US women aged 20 to 49. It was discovered that higher ferritin values were inversely associated with asthma, and both lower body iron and higher sTfR corresponded with lower lung function (135). Although the findings may be confounded by the widespread presence of both asthma and iron deficiency in this population, further studies of the association between iron deficiency and asthma and pulmonary inflammation are warranted.

Iron has also been studied in relation to different aspects of metabolic syndrome, including glucose homeostasis, oxidative stress, obesity, and hypertension. The findings on the role of iron in glucose homeostasis is mixed. Animal models have indicated that iron is crucial to the circadian rhythms of the liver that control glucose (136). Additionally, low iron has a confounding effect on HbA1c values in both diabetic and healthy humans, as some studies have noted an increase in HbA1c values after treatment of iron deficiency. This finding warrants more research, and it could potentially render this diagnostic tool untrustworthy in IDA (137, 138). Conversely, elevated iron has been implicated in insulin resistance and oxidative stress in observational studies (139, 140).

Studies on the association between obesity and iron deficiency to date have largely been observational and have produced mixed results, but they do suggest that the chronic inflammation of obesity may hinder iron absorption. A 2015 Chilean study on women of reproductive age used radio-labeled iron to demonstrate lowered iron absorption for obese participants as compared to both overweight and normal weight, but an association between BMI and iron status did not exist (141). Additionally, a Swiss study of similar design also noted decreased iron absorption in obesity as well as a decreased effect of ascorbic acid to enhance iron absorption (142). For more research on this topic, see the following sources (141, 143-145). Hypertension has also been examined in relation to iron status. A randomized controlled trial found that improvement of iron status with supplementation resulted in a significant decrease in heart rate of female Chinese laborers, compared to a non-supplemented group (146). These findings support a link between iron status and hypertension. Taken together, this data, though mostly observational, warrants more research on iron's role in metabolic syndrome.

Severe IDA has also been researched for its impact on the immune response. This topic has been explored for over 40 years, as it has serious implications for human health. Studies have demonstrated both impaired leukocyte activity and cell-mediated immunity in severe IDA (147-149). A recent human study demonstrated that a genetic mutation in TfR1, resulting in depletion of iron in tissues, severely impaired immunity, furthering support for a role for iron in the immune response (150). Certain diseases, such as chronic kidney disease, have targeted IDA as a serious threat to patient improvement due to its impact on immunity (79). Iron deficiency in the absence of anemia, however, has not been thoroughly researched in its relation to immune response impairment.

A number of gastrointestinal disturbances can induce an iron deficiency. Intestinal inflammation may disrupt iron absorption, and conditions that cause frequent blood loss will increase iron losses. In a recent study of 402 Iranian patients with IDA, 42 patients, or 10.4%, presented with celiac disease (151). These researchers suggested that all patients with IDA be tested for celiac disease, which may be responsible for the development of anemia. Because IDA also impacts immunity, it is logical to presume that the anemic state may also create of cycle of impaired healing, continuous inflammation, impaired iron absorption, and anemia for individuals with certain gastrointestinal disturbances. A 2007 study explored gastrointestinal causes of anemia in 30 patients recently turned away from donating blood. Twenty-five of these patients, or 83%, presented with gastrointestinal disturbances that may cause anemia. These included H. pylori infection, celiac disease, gastric atrophy, gastric polyp, colonic adenoma, ulcerative colitis and cecal angiodysplasia (69). These findings may have implications for the treatment of IDA, which will be discussed below.

Restless leg syndrome (RLS), also called Willis-Ekbom disease, has also been researched in connection to iron deficiency. This complex disease has a genetic component, but it also involves altered dopamine metabolism in the brain due to iron deficiency (152). A recent study that tested alternative diagnostic tools for RLS for vulnerable populations that could not self-report symptoms found serum ferritin to be predictive of RLS (153). Because RLS also involves sleep disturbances, low iron may play a role in disordered sleep.

Thus, numerous conditions have a suggested link to iron deficiency. Given the relative ease and low cost of eliminating iron deficiency, additional studies examining

whether improvement in iron status will ameliorate or eliminate these conditions warrants further investigation.

Treatment

Iron deficiency is treatable through diet, oral supplementation, or intravenous administration. Screening is recommended for certain gastrointestinal disturbances that may induce inflammation, thus reducing iron absorption, or promote blood loss, which increases iron loss. Meat and fish provide the only dietary sources of heme iron, which is much more bioavailable than non-heme iron, as well as meat factor, which increases the absorption of non-heme iron. Non-heme iron sources are better absorbed in the presence of meat, ascorbic acid, and alcohol (other than red wine) and in the absence of phytates, polyphenols, calcium, egg, and soy. Notable sources of non-heme iron in plant sources include legumes and leafy greens. Additionally, iron fortification of refined grains is a noteworthy source in the Western diet. Clearly, the composition of the entire meal affects iron bioavailability. Because of the limited absorptive capacity for iron and increased menstrual losses, the Recommended Dietary Allowance (RDA) for non-pregnant women of childbearing age is 18 mg/day (154). Recent studies on iron bioavailability in the US diet estimate that about 15% of iron consumed will be absorbed, although with great individual variation (155). Clinical trials have noted dietary treatment as an effective method, though less effective than oral supplementation (156).

Oral supplementation was noted as the most common recommendation for treatment of iron deficiency by a 2015 literature review that analyzed 27 iron treatment guidelines. The two most common iron supplements are ferrous sulfate and ferrous fumarate due to their safety and cost. Although generally harmless, oral iron

supplementation can cause some gastrointestinal upset as unabsorbed iron passes through the bowel. For this reason, an upper limit (UL) has been set at 45 mg/day, but this is often exceeded to treat deficiency. Unfortunately, because of these side effects, adherence to supplementation is generally low (71). Additionally, it has been questioned whether oral supplementation can aggravate inflammation in the gastrointestinal tract (157). Nevertheless, its effectiveness, safety, and availability make it the most recommended treatment for iron deficiency.

Intravenous administration of iron is particularly effective in some cases of gastrointestinal upset and chemotherapy treatment, but it also has the potential to do great harm to the patient. More studies are needed on the risk of anaphylactic reactions, increased oxidative stress, and infections. Additionally, the appropriate dosage is still under study (71). Unless advisable due to serious comorbidities, intravenous iron is not recommended for treatment of most cases of iron deficiency.

Depression

Definition and Incidence

Depression is a broad term that encompasses many different classifications of a state of decreased mood, positivity, and enjoyment, and can even have emotional, cognitive, and physical manifestations (158). Because it is generally experienced in normal, healthy individuals at some point in life, challenges arise in its clinical diagnosis; generally, it is diagnosed and characterized based on severity and longevity (159). Its prevalence and its cost both economically and on QOL render it an area of continuing research.

Incidence of depression varies based on diagnostic tools used and categories included, as well as the country, gender, age, and socioeconomic status of individuals. Globally, it is estimated that between 4 and 10 percent of people experience major depressive disorder (MDD) while between 2.5 and 5 percent experience dysthymia, a depression that involves less severe symptoms but has a chronic manifestation (160). On average, the first onset of depression is 20 years old, though this figure is highly variable (161).

It has consistently been demonstrated that females experience a much higher incidence of depression than males. MDD has repeatedly been reported in females at rates 1.5 to 3 times that of males, and female dysthymia has been reported at 2 times that of males (162, 163). Because these differences in incidence arise between 11 and 14 years of age, much speculation is given to female sex hormones or contraceptive use (164). However, epidemiological studies have consistently found no relationship; it is

likely that other biochemical changes along with differing societal pressures are involved in this effect (165).

PPD is a distinct depressive diagnosis reserved only for females. Its only distinguishing characteristic is that it must be experienced within weeks following delivery (166). Depending on the duration and severity, it can have extremely detrimental impacts on family relations and child development (125). Numerous risk factors have been considered in the occurrence of PPD, including iron deficiency.

Signs and Symptoms

The physical, emotional, and cognitive signs and symptoms of depression vary greatly and are the basis for categorical diagnosis. In general, the diagnosis includes lowered mood patterns or persistent pessimism, with a wide variety of other characteristics. Physical signs may include frequent crying, visibly slowed movements, and changes in weight. Behavioral symptoms include frequent irritation, fatigue, social disconnectedness, and sleep disturbances. Thought patterns common in depression include hopelessness, guilt, diminished self-worth, and suicidal ideation. Concentration and attention may also be slowed, with an obsessiveness on past events. In extreme cases, psychosis presents as hallucinations, delusions, or paranoia (158).

Assessment Tools

Two major assessment tools are cited throughout the literature on depression and are the most common diagnostic tools in use. The first, the DSM, was developed by the American Psychiatric Association (APA) and is currently on its fifth edition (DSM-5). The second is the International Statistical Classification of Diseases and Related Health Problems (ICD), developed by the WHO, which is now in its tenth edition (ICD-10).

Both of these tools are in a questionnaire format and aim to diagnose clinically significant depression while further subcategorizing it as mild, moderate, or severe. This subcategorization is based on the total amount, severity, and specificity of reported symptoms. The content of the questions between both assessment tools greatly overlap, and both are clinically relevant to the diagnosis of depression (167).

One common variation of the DSM is the Patient Health Questionnaire (PHQ), currently in its ninth edition (PHQ-9). Still maintaining diagnostic integrity, the strength of this version is its brevity. It has been validated as an important diagnostic tool in over 15 studies (168).

Other assessment tools have emerged for this complex disorder. Some are specific for a certain category of depression, such as the EPDS tool used only for PPD, while others are specific to a certain category of symptoms, such as the POMS used for mood analysis. Additionally, the CES-D has been extremely popular since its first development in 1977 and is commonly used in NHANES (169). The CMI and the DIGS have also been used in depression diagnosis and are seen throughout the literature. All of these assessment tools have been validated, and their use is appropriate for the diagnosis of depression.

Study Objective

The aim of this study is to further investigate iron status and iron deficiency symptoms in menstruating females. It builds on the existing research for use of cutoff values for various biochemical assessments of iron as well as for stages of deficiency in which symptoms are experienced. In addition, samples were taken for future analysis of

vitamin D status, which may be correlated to iron status and will be discussed in a future paper.

Materials & Methods

The protocol for this study was reviewed and approved by the Institutional Review Board (IRB) of the University of Minnesota (UMN). Funding was provided by the Clinical and Translational Science Institute (CTSI) of the UMN. A representative from CTSI provided continuous monitoring of paperwork and protocol.

Data collection

Subjects were recruited from the 2015 Minnesota State Fair at the onsite University of Minnesota Driven to Discover (D2D) building. Data collection occurred on four separate days by the study PI, two graduate students, and two licensed phlebotomists. Additional support was provided during the processing of blood samples in the lab.

The study booth inside the D2D building displayed a sign that requested participation from females aged 18 to 45 in order to recruit menstruating, premenopausal females. Study staff greeted potential subjects and explained the objective of the study; because data from this study is intended to eventually test a correlation between iron deficiency and vitamin D deficiency, the study was explained as such. If age and gender criteria were met and interest was confirmed, subjects were handed a laminated card with additional participation criteria, including that the subject be non-pregnant and free of any serious health conditions. Another laminated card was provided detailing serious health conditions that were exclusionary, including active treatment for cancer, active chronic inflammatory diseases (IBS, colitis, Crohn's disease), chronic heart failure, chronic kidney disease, chronic parasitic infection, hemochromatosis, HIV, PCOS,

respiratory illness (such as severe asthma), sickle cell anemia, and thalassemia. These conditions were excluded in order to avoid the potential effect of chronic inflammation on iron measures such as ferritin and TIBC. A few subjects that were over 45 years of age were included upon verbal confirmation that they were premenopausal.

Upon confirmation that all criteria were met, subjects selected a code in the form of a sheet of stickers labeled 100 through 200 that could adhere to blood tubes to protect their identity throughout the study. The subject's name and code were then entered by staff into the Subject Enrollment Log provided by CTSI. If personal iron and vitamin D results were desired, subjects entered their name, code, physical address, and email address on a contact sheet. Staff then explained the contents of the consent form, which had been approved by the IRB, and subjects signed this form and were offered a personal copy. Finally, subjects signed an additional document that stated they had willingly given informed consent and met the eligibility criteria.

Subjects then completed the study survey electronically, using an iPad, while seated at a table. After entering their study code, subjects responded to a number of physical, emotional, medical, and dietary questions, including the PHQ9, a validated depression assessment (168). Please see Appendix A for the complete survey. On average, the survey took 20 minutes to complete.

Upon survey completion, staff gathered each subject's biometric data. Name, age in years, and code were recorded first. Because the subjects had been sitting for roughly 20 minutes in a presumably restful state, blood pressure was taken before rising using an OMRON 7 Series Blood Pressure Monitor device. Subjects' height was then measured in cm using a stadiometer, and both weight in kg and percent body fat were recorded using a

bioelectrical impedance scale (model BF684W; Tanita Corporation of America, Arlington Heights, Ill). Staff then calculated each subject's BMI in kg/m^2 using the height and weight data.

Subsequently, subjects were directed to one of the two phlebotomists, who collected three 7 mL tubes for serum and one 6 mL lithium heparin-coated tube for plasma, for a total of approximately 27 mL taken. The serum tubes were placed in test tube racks on a table to rest at room temperature for a half hour and were then placed into an ice chest, while the plasma tubes were immediately placed in the ice chest. Upon completion, subjects were compensated ten dollars for their participation and signed a receipt stating that they had received payment.

One hundred ninety subjects participated. Day 1 included subjects 100-143. Day 2 included subjects 144-188. Day 3 included subjects 189-241. Subject 194 consented and began the survey on this day, and then returned on Day 4 to retake the survey and complete data collection. No data was associated with code 210, and it was hypothesized that this code sticker sheet was lost. Additionally, two subjects were assigned the code 221, so one was designated as such while the other was designated as 221A. Finally, Day 4 included subjects 242 to 289. Subject 260 did not take the survey at the fair, so she completed the survey the next day in our laboratory in the FScN building.

Processing of the blood samples occurred immediately after the State Fair shift in the laboratory. Blood from the plasma tubes were used for the hemoglobin assay and to determine hematocrit. After inverting the plasma tube several times, 20 μL of whole blood was collected into tubes for hemoglobin analysis and stored at 4° C overnight until

analysis the next day. Hematocrit was determined from whole blood drawn from the plasma tube.

All serum tubes, as well as the plasma tubes that had already been used for hemoglobin and hematocrit, were centrifuged at 3000 g for 15 minutes to collect serum and plasma, respectively, and appropriate volumes were aliquoted into microcentrifuge tubes and stored at -80° C until assayed. Albumin was chosen to determine protein sufficiency, and CRP and AGP were chosen to assess inflammation (170).

Biochemical analysis of iron status

Hematocrit was determined during the processing of blood samples after each State Fair shift. Please see the Data Collection section above for details.

All hemoglobin analysis was performed the afternoon after blood collection, with the exception of the samples collected on Day 3. Because Day 4 fell directly after Day 3, samples from Day 3 and Day 4 were run together on September 7th.

Hemoglobin concentration of the whole blood samples was determined using Drabkin's reagent (Cat. No. D5941, Sigma-Aldrich, St. Louis, MO), using a certified hemoglobin standard (H7506-STD, Pointe Scientific, Canton, MI) for quantitation of the hemoglobin concentration.

Serum ferritin was quantitated using ELISA kits (25-FER HU-EO1, ALPCO, Salmen, NH) according to the manufacturer's instructions. Bio-Rad anemia controls with matching lot numbers (43240) were run concurrently with each plate. The ferritin assay was run on 5 separate days. The ferritin concentrations of the standards provided in the ELISA kit were as follows: 0 ng/mL, 15 ng/mL, 80 ng/mL, and 250 ng/mL. The standards, anemia control, and samples were run in duplicate.

Total iron binding capacity (TIBC) of serum samples was determined by the method of Siek et al. (171), adapted for manual use. For quantitation, five serum samples were analyzed for TIBC by a commercial laboratory (Marshfield Laboratories, Marshfield, WI). These serum samples were then used as calibrators for the TIBC analysis.

Symptomatic measures of iron deficiency

Fatigue was self-reported in this survey as experiencing fatigue or exhaustion several days, more than half the days, or nearly every day in the past month. Those who reported fatigue occasionally were not categorized as fatigued. Classic physical symptoms were grouped as summations of skin, nails, hair, eyes, and thermoregulation symptoms that subjects self-reported as experiencing in the last month. See Appendix A for specific deficiency symptoms within these categories. Other classic symptoms of iron deficiency included dizziness, shortness of breath, decreased work ability, fatigue after eating or sleeping, headaches, migraines, and racing thoughts that prevent sleep. Those who self-reported as experiencing these symptoms several days, more than half the days, or nearly every day in the past month were categorized as experiencing the symptom; those who reported experiencing these symptoms occasionally were not categorized as experiencing the symptom. Dizziness and shortness of breath were grouped together as symptoms that are specific to iron deficiency. The variable "select deficiency symptoms" was created from the summation of these two symptoms with a cutoff of 4, indicating participants that experienced these symptoms several days, more than half the days, or nearly every day in the last month. Symptoms of craving included pica-like activities, a frequent starving sensation, and frequent thirst, as well as craving sugar, chocolate,

carbohydrates, or salt. The variable "craving symptoms" was created as a summation of the aforementioned symptoms, and those who scored 21 or greater, indicating those who self-reported as experiencing cravings several days, more than half the days, or nearly every day in the past week for multiples of these characteristics, were categorized as experiencing craving symptoms. Those who scored less than 21 on the craving symptoms sum were not categorized as experiencing cravings.

Cognition

EF characteristics included short term memory, long term memory, a summation of memory issues including both short and long term, alertness and concentration, ADD or ADHD tendencies, math ability, and motility. Affective analysis included the PHQ9 depression screen in addition to feeling sad, crying easily, ease of anger, stress or moodiness, obsessive compulsive disorder (OCD) tendencies, or feeling emotionally unresponsive. The PHQ9 was scored in accordance with its directions as such: category 1 indicates minimal depression with a score of 9 to 13, category 2 indicates mild depression with a score of 14-18, category 3 indicates moderate depression with a score of 19-23, category 4 indicates moderately severe depression with a score of 24 to 28, and category 5 indicates severe depression with a score of 29 to 36. In this analysis, subjects were considered to be depressed if they were categorized as moderately to severely depressed, and those with minimal or mild symptoms were not considered depressed.

Thyroid issues, blood sugar, and insufficient sleep

Thyroid issues were categorized as those who self-reported taking thyroid medication several days, more than half the days, or nearly every day of the week, or

those that reported currently experiencing a thyroid condition. Low blood sugar was self-reported as experienced several days, more than half the days, or nearly every day within the last month. Subjects who reported occasional low blood sugar were not categorized as experiencing the symptom. Insufficient sleep was categorized as sleeping less than 6 hours each night on average.

Statistical analysis

All statistical analysis was performed using the Statistical Analysis System Software (version 9.4; SAS Institute, Cary, NC). Contingency tables assessed association between categorical variables through chi-square analysis. For cells containing 5 or less subjects, analysis was performed using the Fisher's Exact test. PROC CORR analyzed the correlation between variables. PROC REG was used to perform linear regression by least-squares. The commonly accepted significance value of $p \leq 0.05$ was considered statistically significant. Please see Appendix B for the complete SAS program file with individual data.

Affective characteristics were analyzed through contingency tables with the biochemical measures alone or with the addition of the select deficiency symptoms, described above as experiencing dizziness and shortness of breath.

Results

Subjects

Eight subjects were eliminated from the analysis, leaving 182 subjects. Four subjects noted a past hysterectomy in the survey, rendering them unfit for inclusion. Four additional subjects were excluded as two survey codes appeared in duplicate, preventing differentiation.

Biochemical measures of iron deficiency

The four biochemical measures of iron status for the 182 subjects analyzed are shown in Table 3-1. Iron status was determined by using cutoff values for the four iron measures. All mean iron values were in the normal range with the exception of ferritin. Hct and Hb results were used to classify subjects as anemic or non-anemic. A Hct reading below 38% or a Hb value below 12 g/dL was used as an indication of anemia. Additionally, a ferritin concentration of 20 ng/mL or lower and a TIBC value greater than 400 μg/dL were considered indicative of iron deficiency (ID). Additionally, those subjects who were iron deficient without anemia are indicated as IDNA. Figure 3-1 indicates the percent of subjects that are iron sufficient or iron deficient in terms of anemia, ferritin values, TIBC values, ID, and IDNA. The incidence of anemia was 14.8%, and 24.7% were ID. The majority of subjects (73.6%) had ferritin deficient values. Figure 3-2 details ferritin status for all subjects using cutoff values of both 12 ng/mL and 20 ng/mL. With the more conservative cutoff of 12 ng/mL, 50% of subjects remain below the cutoff. Figure 3-3 illustrates that no correlation was found between BMI and serum ferritin concentrations. As obesity is associated with a low-grade

Table 3-1: Biochemical measures of iron status for all subjects

Iron status measure	**Value (Mean ± SEM)**
Hematocrit (%)	41.9 ± 0.2[1]
Hemoglobin (g/dL)	13.3 ± 0.1
Ferritin (ng/mL)	15.7 ± 1.1
TIBC (μg/dL)	373.6 ± 4.8

[1]Values represent means ± standard error of the mean (SEM); n=182 for all biochemical measures.

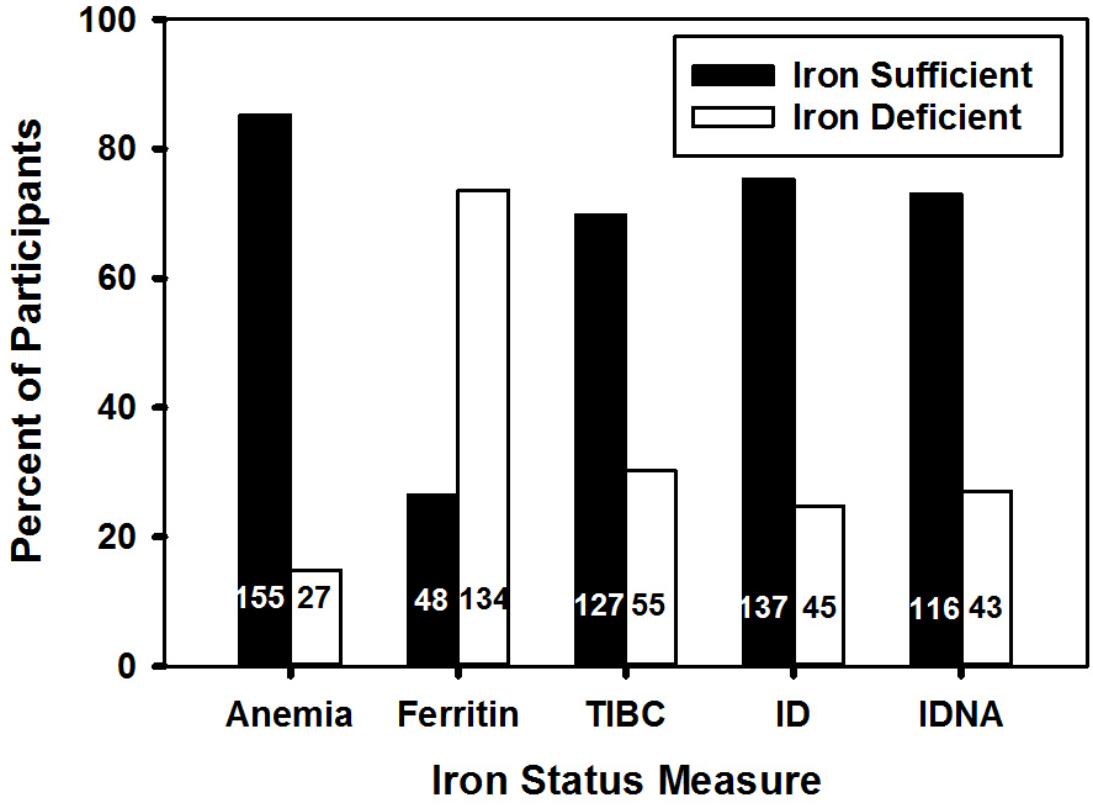

Figure 3-1: Categorization of iron status of subjects based on cutoff values for the biochemical measures.

Numbers within bars indicate the number of subjects within that category. For anemia, ferritin, TIBC, and ID n=182; n=159 for IDNA due to exclusion of 27 anemic subjects. A Hct reading below 38% or an Hb value below 12 g/dL indicated anemia. Subjects with a ferritin value ≤ 20 ng/dL and a TIBC value > than 400 μg/dL were considered iron deficient (ID). Subjects that were ID and not anemic were categorized as IDNA.

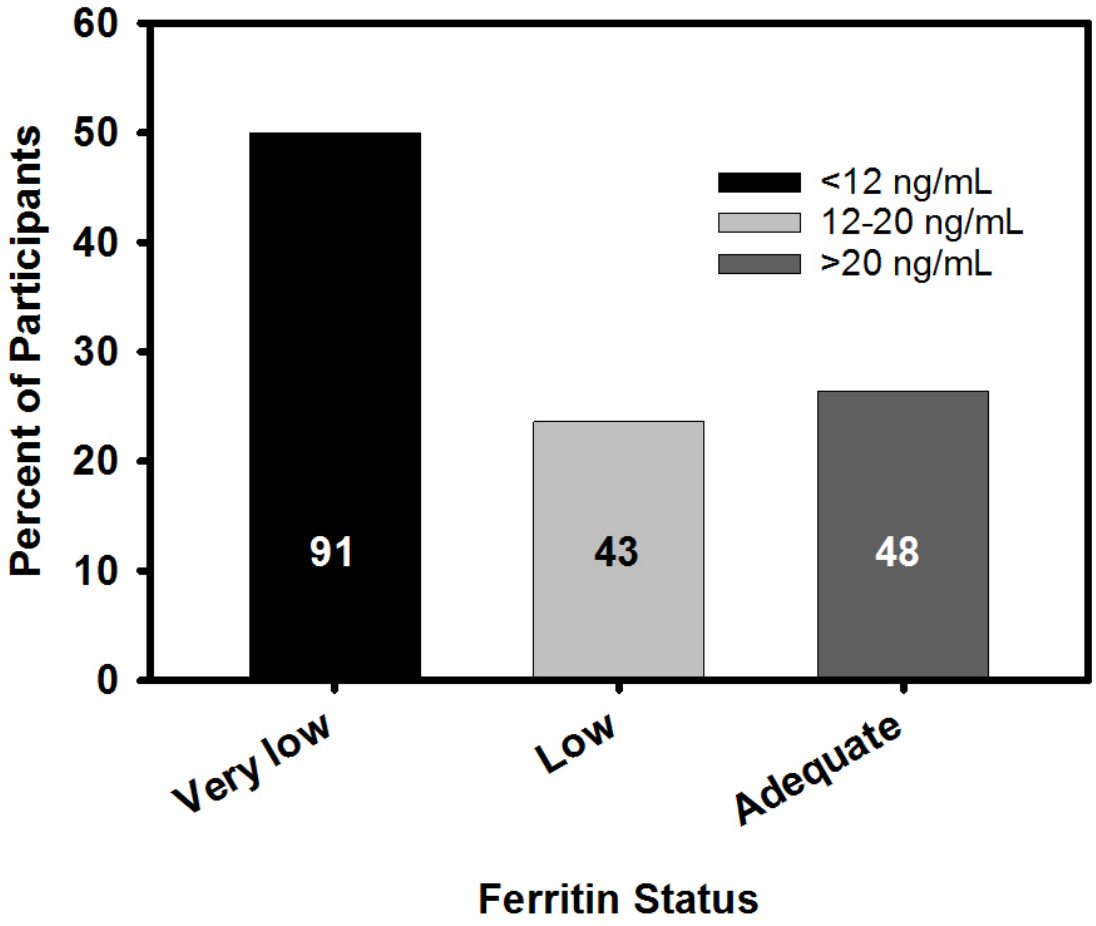

Figure 3-2: Ferritin status of subjects by percent.

Numbers within bars indicate the number of subjects within each category; n=182.

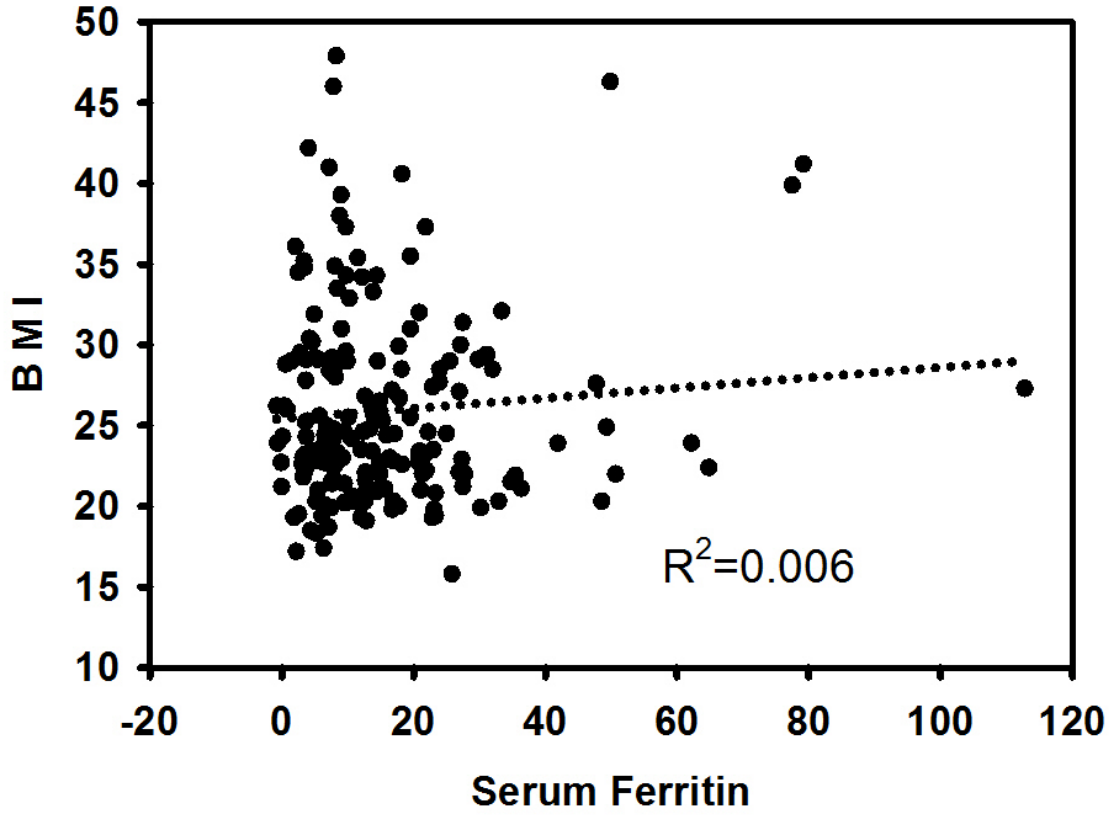

Figure 3-3: Correlation between serum ferritin and body mass index (BMI)

There was no statistically significant correlation (R^2=0.007; p=0.27); n=182.

inflammation (143), these results further suggest that obesity-induced inflammation did not influence ferritin values.

Symptomatic measures of iron deficiency

Using cutoffs values, neither serum ferritin nor TIBC concentrations significantly associated with fatigue (Chi Square p=0.85 and p=0.12, respectively). Eleven of the 27 anemic subjects (40.7%) reported fatigue whereas only 44 of the 155 non-anemic subjects (28.4%) reported fatigue; however, this difference was not statistically significant (p=0.197). ID subjects were significantly more likely to report fatigue than those who had at least one iron sufficient value for ferritin or TIBC, with 19 of the 45 ID subjects (42.2%) reporting fatigue whereas only 36 of the 137 subjects (26.3%) with normal ferritin or TIBC values reported fatigue (p=0.043). Additionally, 17 of the 43 IDNA subjects (39.5%) reported fatigue whereas only 29 of 116 subjects (25%) who were not anemic and had either a normal ferritin or TIBC value had fatigue, a difference that approached statistical significance (p=0.073).

Dizziness correlated with ferritin status as 13 of the 134 subjects with ferritin deficient values reported dizziness (9.7%) while none of the 48 subjects with ferritin sufficient values reported dizziness (0%; p=0.0251). Shortness of breath followed the same pattern, as 7 of the 134 subjects with ferritin deficient values reported shortness of breath (5.22%) while none of the 48 subjects with ferritin sufficient status reported shortness of breath (0%); however, this difference was not statistically significant (p=0.1063). Additionally, 4 of the 45 ID subjects reported shortness of breath (8.89%) while 3 of the 137 subjects with either iron sufficient ferritin or TIBC values reported shortness of breath (2.19%; p=0.0426). Finally, of the 43 IDNA subjects, 4 reported

shortness of breath (9.3%) while 2 of the 116 subjects who were not anemic and had at least one iron sufficient ferritin or TIBC value reported shortness of breath (1.72%; p=0.0259). Dizziness and shortness of breath, which represent symptomatic iron deficiency, were then combined for additional analysis of correlation with other iron deficiency symptoms. This combination is termed select deficiency symptoms.

Depression and other affective characteristics were analyzed using contingency tables to the biochemical measures of iron status both alone and with the addition of select deficiency symptoms. Twenty-two participants reported taking antidepressants nearly every day (12.09%). Analysis for depression excluding these subjects was essentially the same as when all subjects were included. For this reason, subjects taking antidepressants were included in the depression analysis.

Depression severity as assessed by the PHQ9 is shown in Figure 3-4. Of the 182 subjects analyzed, 19 (10.44%) were classified as moderately to severely depressed. Depression severity was not significantly correlated with any biochemical measure of iron status alone. However, addition of the select deficiency symptoms to the biochemical measures resulted in a significant association with depression. As shown in Figure 3-5, if select iron deficiency symptoms were not present, depression incidence was low despite anemia status. However, if select deficiency symptoms were present, incidence of depression increased, and 4 of the 5 (80%) subjects who were anemic and experiencing the select deficiency symptoms were categorized as depressed ($p < 0.0001$).

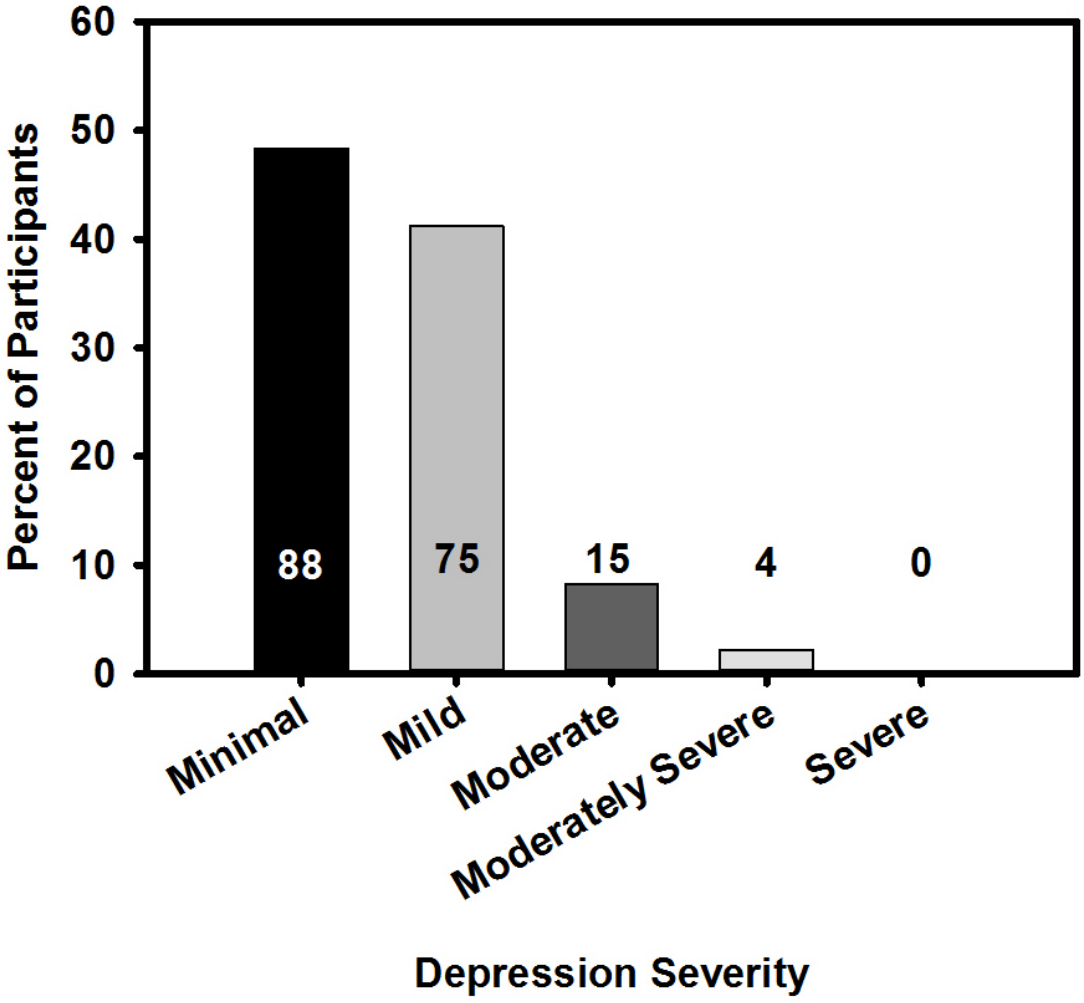

Figure 3-4: Depression severity assessed by the PHQ9

n=182. Numbers within bars indicate the number of participants within that category (n). The PHQ9 was scored in accordance with its directions as such: category 1 indicates minimal depression with a score of 9 to 13, category 2 indicates mild depression with a score of 14-18, category 3 indicates moderate depression with a score of 19-23, category 4 indicates moderately severe depression with a score of 24 to 28, and category 5 indicates severe depression with a score of 29 to 36. See Appendix A question 4 (Q 4) for PHQ9 questions.

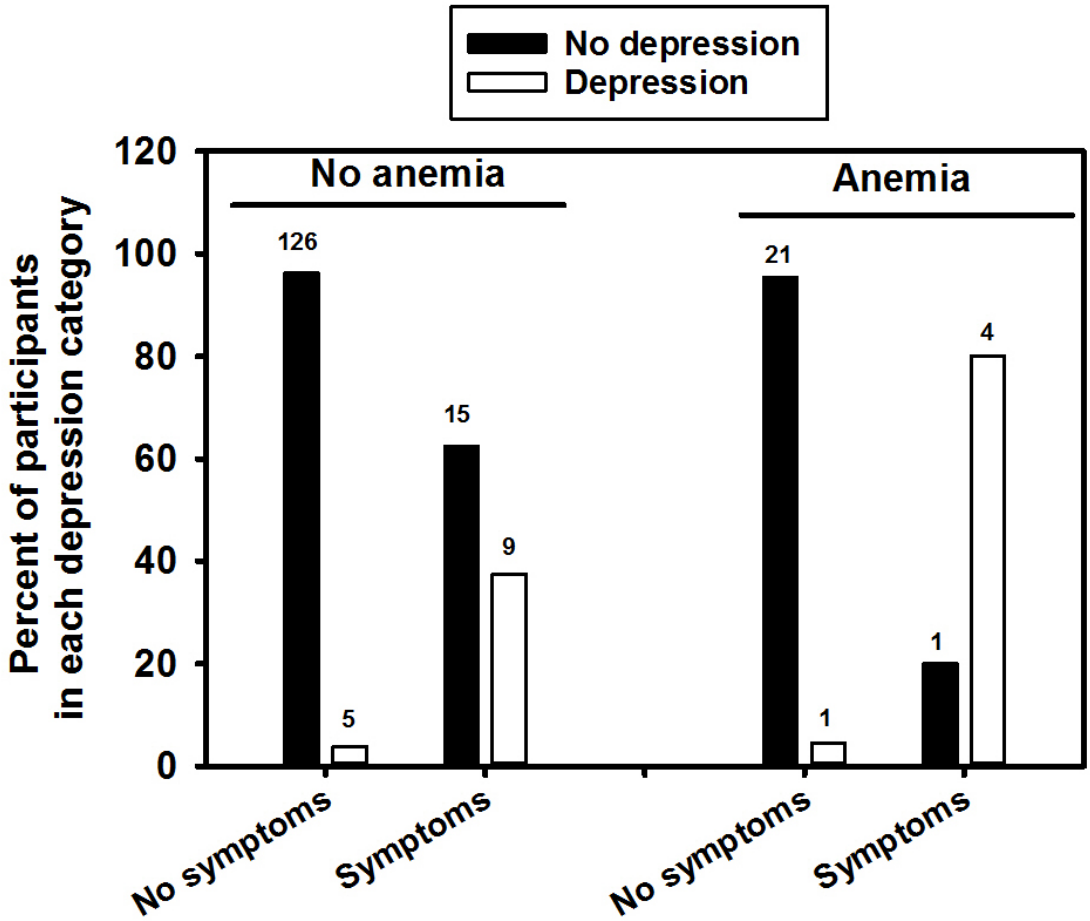

Figure 3-5: Impact of anemia and select deficiency symptoms (dizziness and shortness of breath) on depression incidence

n=131 for no anemia and no select deficiency symptoms. n=22 for anemia and no select deficiency symptoms. n=24 for no anemia and select deficiency symptoms. n=5 for anemia and select deficiency symptoms. Numbers within bars indicate the number of participants within that category (n). See Figure 3-1 for a description of anemia. Select deficiency symptoms were self-reported in this survey as experiencing dizziness or shortness of breath several days, more than half the days, or nearly every day in the past month. Those who reported dizziness or shortness of breath occasionally were not categorized as having select deficiency symptoms. See Figure 3-3 for a description of PHQ9 scoring and categorization. Subjects were considered to be depressed if they were categorized as moderately to severely depressed, and those with minimal or mild symptoms were considered not depressed.

Similar trends were seen with other affective and executive functioning (EF) characteristics. As shown in Figure 3-6, stress or moodiness had a higher incidence than depression in this population overall, but incidence was greatest in those experiencing select deficiency symptoms. Additionally, 80% of subjects who were anemic and experiencing select deficiency symptoms reported stress or moodiness ($p = 0.0002$). As seen in Figure 3-7 and 3-8, ease of anger and emotional unresponsiveness followed a similar pattern, where the select deficiency symptoms were associated with a greater incidence of these characteristics, and incidence was greatest in those who were anemic and also experiencing select deficiency symptoms (60%; $p < 0.0001$). Finally, alertness and concentration, representative of an EF characteristic, followed a similar pattern. As seen in Figure 3-9, the select deficiency symptoms increased the incidence of alertness and concentration problems, and incidence was greatest in those who were anemic and also experiencing select deficiency symptoms (60%; $p < 0.0001$).

A number of other associations with iron deficiency reported in the literature were analyzed. No associations were found between the biochemical iron measures and dietary habits, including self-reported consumption of meat and a number of other known enhancers and inhibitors of non-heme iron absorption. Blood donation, menstrual blood loss, asthma, exercise, gastrointestinal issues, restless leg syndrome, BMI, percent body fat and blood pressure also did not correlate with biochemical measures of iron status. As Table 3-2 illustrates, anemia was significantly correlated with thyroid problems, low blood sugar, and insufficient sleep.

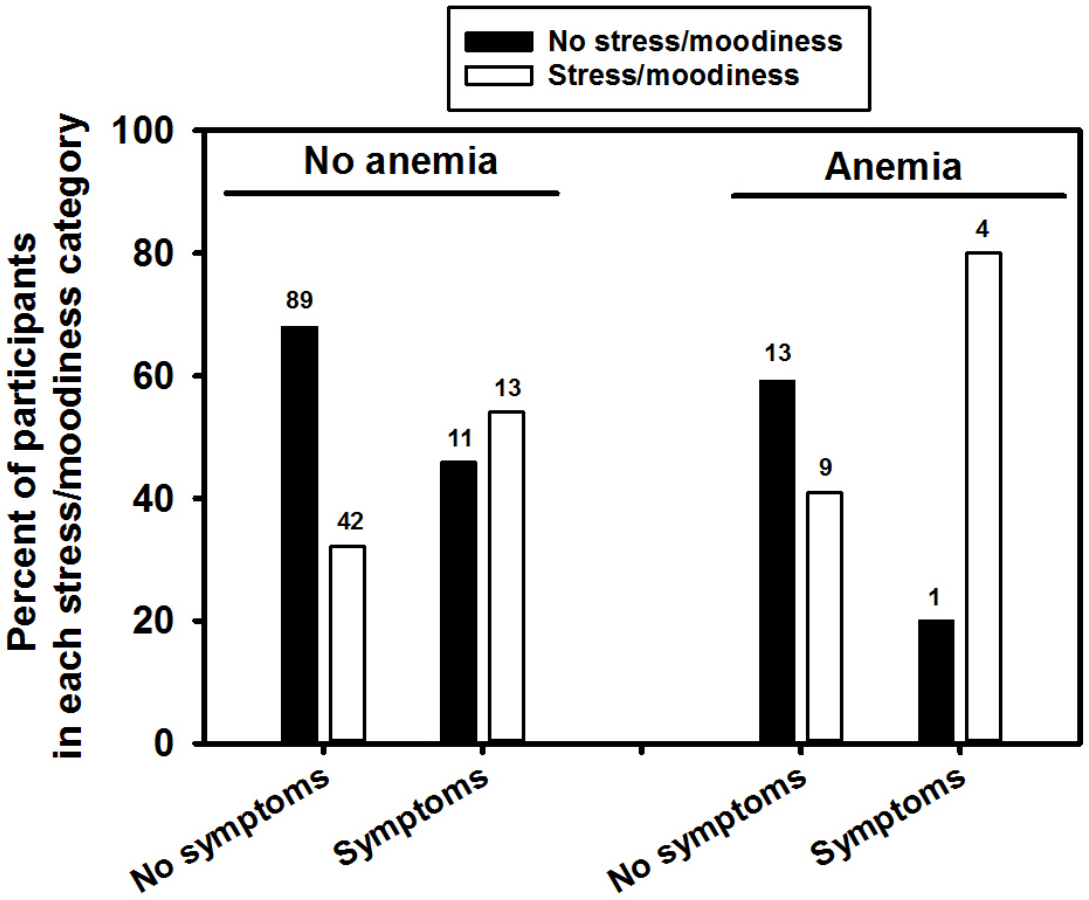

Figure 3-6: Impact of anemia and select deficiency symptoms (dizziness and shortness of breath) on stress or moodiness incidence

n=131 for no anemia and no select deficiency symptoms. n=22 for anemia and no select deficiency symptoms. n=24 for no anemia and select deficiency symptoms. n=5 for anemia and select deficiency symptoms. Numbers within bars indicate the number of participants within that category (n). See figure 3-1 for a description of anemia. Select deficiency symptoms were self-reported in this survey as experiencing dizziness or shortness of breath several days, more than half the days, or nearly every day in the past month. Those who reported dizziness or shortness of breath occasionally were not categorized as having select deficiency symptoms. Stress or moodiness was self-reported in this survey as experiencing stress or moodiness several days, more than half the days, or nearly every day in the past month. Those who reported stress or moodiness occasionally were not categorized as experiencing stress or moodiness.

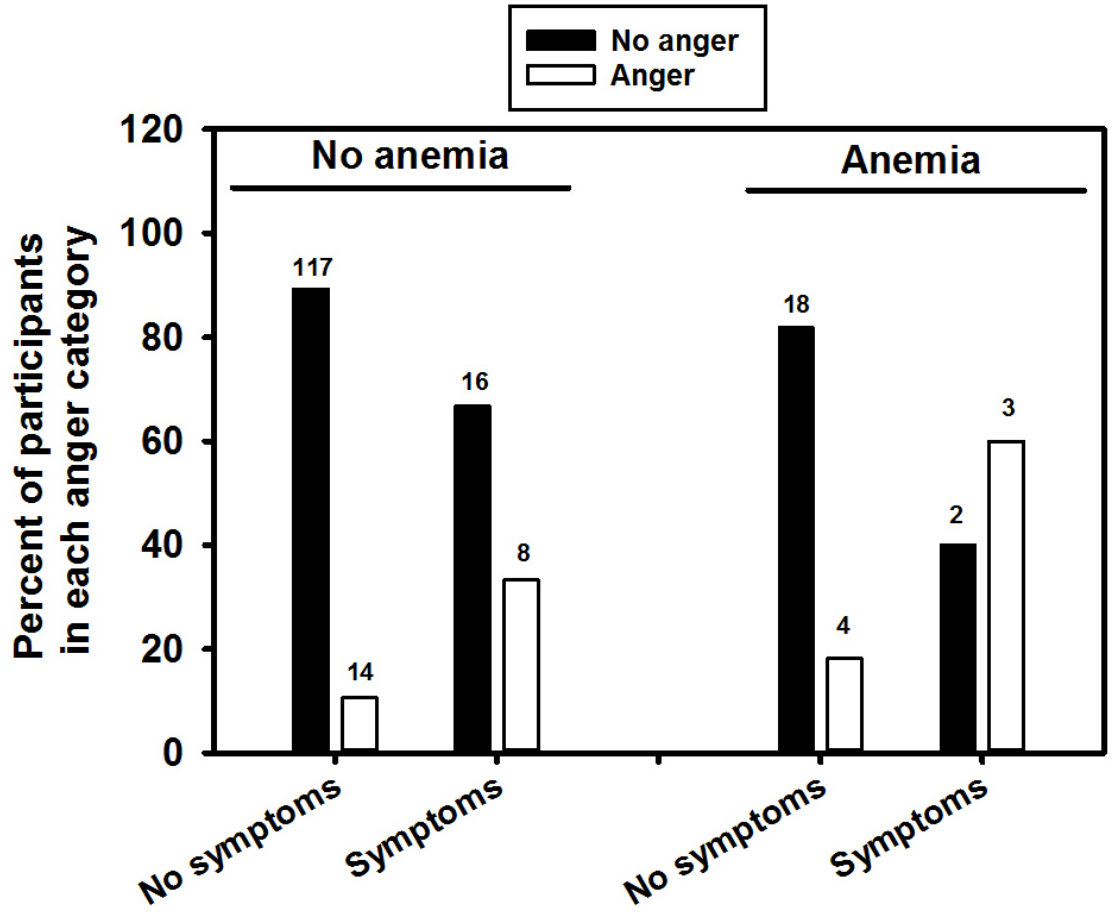

Figure 3-7: Impact of anemia and select deficiency symptoms (dizziness and shortness of breath) on ease of anger incidence

n=131 for no anemia and no select deficiency symptoms. n=22 for anemia and no select deficiency symptoms. n=24 for no anemia and select deficiency symptoms. n=5 for anemia and select deficiency symptoms. Numbers within bars indicate the number of participants within that category (n). See figure 3-1 for a description of anemia. Select deficiency symptoms were self-reported in this survey as experiencing dizziness or shortness of breath several days, more than half the days, or nearly every day in the past month. Those who reported dizziness or shortness of breath occasionally were not categorized as having select deficiency symptoms. Ease of anger was self-reported in this survey as experiencing ease of anger several days, more than half the days, or nearly every day in the past month. Those who reported ease of anger occasionally were not categorized as experiencing ease of anger.

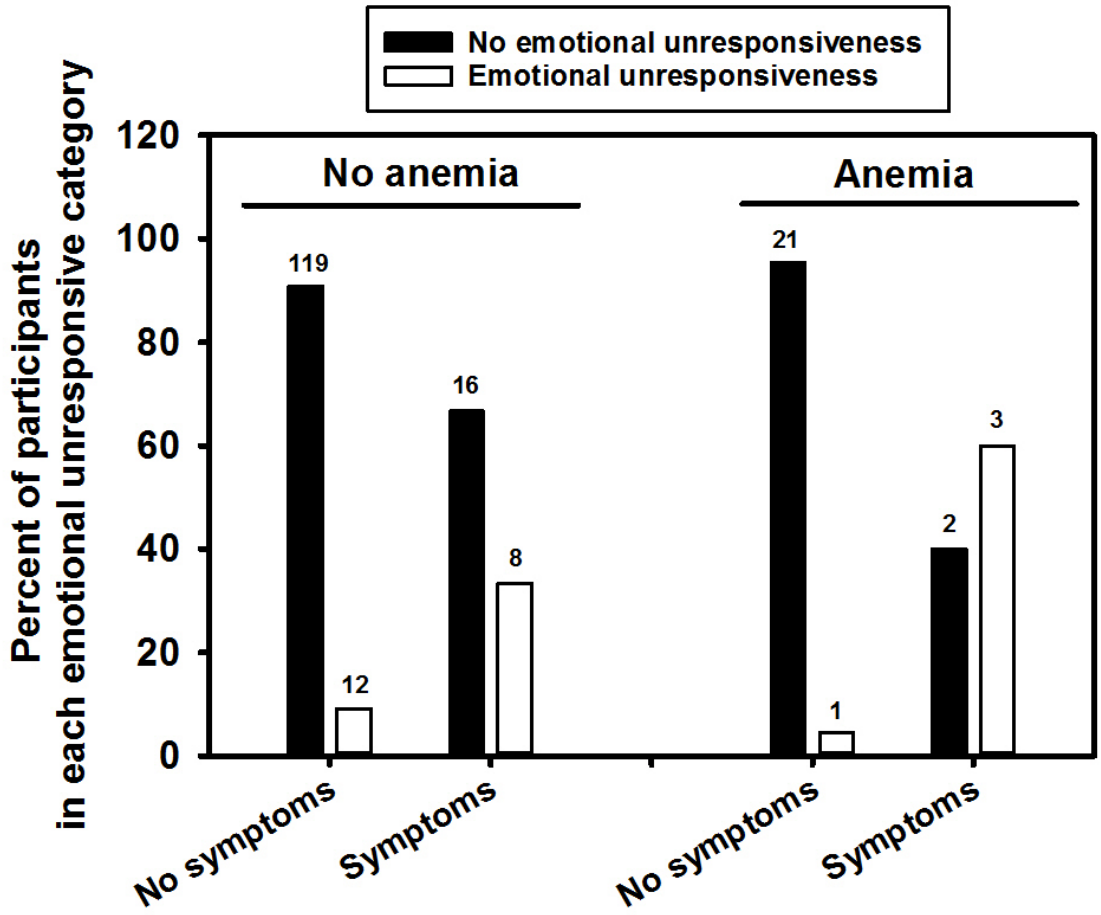

Figure 3-8: Impact of anemia and select deficiency symptoms (dizziness and shortness of breath) on emotionally unresponsive incidence

n=131 for no anemia and no select deficiency symptoms. n=22 for anemia and no select deficiency symptoms. n=24 for no anemia and select deficiency symptoms. n=5 for anemia and select deficiency symptoms. Numbers within bars indicate the number of participants within that category (n). See figure 3-1 for a description of anemia. Select deficiency symptoms were self-reported in this survey as experiencing dizziness or shortness of breath several days, more than half the days, or nearly every day in the past month. Those who reported dizziness or shortness of breath occasionally were not categorized as having select deficiency symptoms. Emotional unresponsiveness was self-reported in this survey as being emotionally unresponsive several days, more than half the days, or nearly every day in the past month. Those who reported emotional unresponsiveness occasionally were not categorized as being emotionally unresponsive.

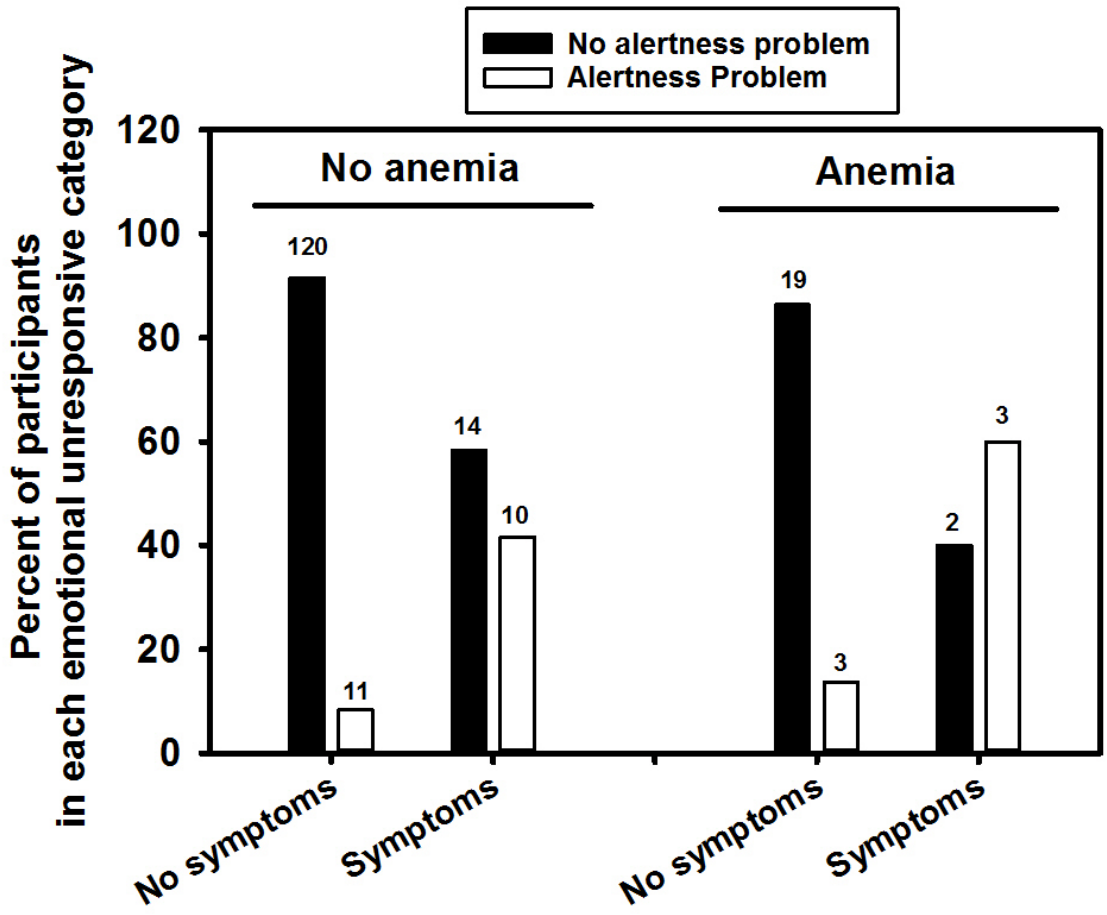

Figure 3-9: Impact of anemia and select deficiency symptoms (dizziness and shortness of breath) on the incidence of alertness and concentration problems

n=131 for no anemia and no select deficiency symptoms. n=22 for anemia and no select deficiency symptoms. n=24 for no anemia and select deficiency symptoms. n=5 for anemia and select deficiency symptoms. Numbers within bars indicate the number of participants within that category (n). See figure 3-1 for a description of anemia. Select deficiency symptoms were self-reported in this survey as experiencing dizziness or shortness of breath several days, more than half the days, or nearly every day in the past month. Those who reported dizziness or shortness of breath occasionally were not categorized as having select deficiency symptoms. Alertness and concentration problems were self-reported in this survey as experiencing alertness and concentration problems several days, more than half the days, or nearly every day in the past month. Those who reported alertness and concentration problems occasionally were not categorized as having alertness and concentration problems.

Table 3-2: Other deficiency symptoms associated with anemia

Symptom	**Anemic**[1] (27)[2]	**Not Anemic** (155)	**p value**
Thyroid[3]	22.2[4]	7.7	0.0200
Low blood sugar[5]	11.1	2.6	0.0334
Insufficient sleep[6]	25.9	6.5	0.0013

[1]Either a hematocrit reading below 38% or a hemoglobin value below 12 g/dL indicated anemia.
[2] Number of subjects.
[3] Thyroid issues were categorized as those who self-reported taking thyroid medication several days a week, more than half the days of a week, or nearly every day, or those that reported currently experiencing a thyroid condition.
[4] Values indicate the percent of subjects.
[5] Low blood sugar was self-reported as experienced several days, more than half the days, or nearly every day within the last month. Subjects who reported occasional low blood sugar were not categorized as experiencing the symptom.
[6] Insufficient sleep was categorized as sleeping less than 6 hours each night on average.

Discussion

The average value for all biochemical measures of iron status fell within the normal range with the notable exception of ferritin. In this study, 14.8% of subjects were anemic based on either Hb or Hct cutoff values. For non-pregnant women aged 15-49, the global estimate for anemia is about 33%, or one third of the population. However, in regions of higher affluence, anemia is estimated to be approximately 14% (63), which is in agreement with our findings.

A very high proportion of the subjects, 73.6%, had ferritin concentrations indicating iron-deficiency, based on a 20 ng/mL cutoff value. Though this ferritin cutoff is commonly used, it is a debated value, and some researchers utilize a more conservative cutoff value of 12 ng/mL (71, 73). Although the average ferritin concentration is above this lower cutoff value, 91 subjects (50%) still have ferritin values indicating iron deficiency using this more conservative criterion. These data suggest that inflammation likely did not influence our results, as ferritin is a positive acute phase reactant; that is, concentrations are elevated in inflammation, so the high proportion of low ferritin values suggests minimal influence due to inflammation. Although a number of inflammatory conditions were used as exclusion criteria for the study, obesity, which induces a low-grade inflammatory state, was not (143). If the inflammation associated with obesity had influenced the results, it would be expected that subjects with a higher BMI would have a greater concentration of ferritin. However, there was no significant correlation between either BMI or percent body fat and serum ferritin concentrations. This suggests that inflammation due to obesity likely did not influence ferritin concentrations in this study. Overall, my results suggest that a majority of the study subjects had low iron stores. This

is an extremely high prevalence of low ferritin concentrations compared to other studies. Data from the 2003-2008 NHANES of 599 non-pregnant US females aged 20-49 noted a mean serum ferritin value of 46.04 ng/mL and a lower quartile value of 17 ng/mL (172). These results indicate that 25% of the subjects had serum ferritin values less than 20 ng/mL, which is a markedly lower prevalence of deficient ferritin values than the present study. It has been reported that lower iron stores may be more prevalent among females in University settings (109). Our study population included a number of University of Minnesota students, due to the close proximity of the University to the State Fair grounds. Because ferritin is a widely used method to assess iron status and an important early indicator of iron depletion, the extremely low ferritin status of this population is of concern (71). Despite their low ferritin values, nearly 70% of subjects had TIBC values within the iron-sufficient range. Production of transferrin increases in iron deficiency, but only after iron stores are significantly depleted (173). Our results indicate that the majority of subjects in this study had depleted iron stores but not to the degree that they had increased production of transferrin or had become anemic. Because no correction for inflammation was used in this study, it may be that the incidence of low ferritin was even higher than our findings indicate.

Fatigue is the most commonly reported symptom of iron deficiency (111). Its subjective nature, due to self-reporting, may have hindered finding an association with the biochemical iron values. Additionally, if experienced for an extended period, fatigue may no longer be obvious; this normalizing effect may have prevented its association with anemia, which tends to develop over time. Nevertheless, both the ID and IDNA groups had statistically significant associations with fatigue. Additionally, in this study,

iron deficient ferritin values were a requirement for experiencing symptoms of dizziness and shortness of breath. Shortness of breath was also significantly correlated with ID and IDNA. The exact mechanisms are unknown, but likely fatigue, dizziness, and shortness of breath in iron deficiency are due to hypoxic conditions from the lack of hemoglobin or from depletion of iron-sulfur proteins in the TCA cycle or electron transport system in mitochondria (91). Although lack of oxygen is apparent due to anemia, it is not yet known at what phase of iron deficiency depletion of iron-sulfur proteins within the TCA cycle or electron transport chain occurs; it may be that these enzymes are affected by iron deficiency in the absence of anemia.

My study was particularly interested in combining biochemical signs of iron deficiency, using hemoglobin, hematocrit, ferritin, and TIBC cutoffs, with symptomatic iron deficiency, indicated by classically reported symptoms in the literature, to assess a correlation with depression and other affective characteristics, such as stress or moodiness, ease of anger, and emotional unresponsiveness. We hypothesized that biochemical assessments of iron status alone are not predictive of iron deficits that are severe enough to produce deficiency symptoms, and that the addition of a well-accepted symptomatic measure may greatly improve the ability to reveal other iron deficiency symptoms. Because fatigue is also a symptom of depression and closely related to the other affective characteristics mentioned, it was not chosen as a symptomatic measure of iron deficiency. Instead, dizziness and shortness of breath were chosen, as these are well-established symptoms of iron deficiency in the literature that do not correlate with depression (64). The combination of these two iron deficiency symptoms is referred to as the select deficiency symptoms.

Twenty-two (12.09%) subjects reported taking anti-depressant medication nearly every day. The prevalence of antidepressant use among premenopausal women has been reported as high and increasing. A study that examined antidepressant medication use by comparing data from the US National Comorbidity Survey from 1990-1992 to 2001-2003 found that over this time use of antidepressants increased fourfold; additionally, trends indicate that females were more often treated than males, and the treatment of less severe depression was increasing more than the treatment of severe psychosis (174). The increased diagnosis and treatment of depression among females has been reported numerous times, and the WHO's Global Burden of Disease Study determined that Major Depressive Disorder was the principal cause of disability related to disease for females internationally (165). As Figure 3-4 illustrates, 10.44% of participants reported moderate to severe depression as assessed by the PHQ-9. These results further the evidence that depression is prevalent among adult females and may severely impact quality of life within this population.

Depression did not correlate with any biochemical measurement of iron in isolation. Overall, studies examining the association between iron deficiency and depression have been inconsistent, and most are correlative in nature. A 2003 observational study in France noted that in females aged 35-60, higher reports of adequate mental health came from iron sufficient women, but the results did not reach statistical significance (68). In contrast, in a 2007 Iranian study of females aged 20 to 30, mean ferritin values in the depressed subjects were significantly lower than in those who did not present with depression, and the incidence of iron deficiency was 15% higher in the depressed subjects (128). In my study, as shown in Figure 3-5, the select deficiency

symptoms showed a correlation with depression despite anemia status. Additionally, when both anemia and the select deficiency symptoms were present, incidence of depression was highest. Importantly, other studies have successfully used fatigue, an indicator of symptomatic iron deficiency, to predict the incidence of depression among adult females. A 2002 observational study noted a significantly greater incidence of post-partum depression (PPD) in patients who also reported fatigue (175). Additionally, the correlation between PPD and iron deficiency is well established, and symptoms of PPD have been successfully treated with iron supplementation (113, 124, 125), which strongly implicates iron deficiency as the cause of the fatigue that is associated with a higher incidence of PPD. However, fatigue may have a confounding effect on these results as it is also a symptom of depression (158). For these reasons, dizziness and shortness of breath, which are not correlated with depression itself but are well-established symptoms of iron deficiency, were chosen as symptomatic indicators of iron deficiency. When these were combined with anemia the correlation with depression increased. I suggest that the presence of these select deficiency symptoms combined with biochemical markers of low iron status may indicate subjects that are functionally iron deficient, and that a functional iron deficiency may be necessary for depression related to iron deficiency to manifest. If such an association is in fact present, iron supplementation of depressed subjects experiencing these deficiency symptoms would be a relatively easy approach to determine a causal relationship.

As shown in Figure 3-6 through Figure 3-9, other affective and executive functioning (EF) characteristics, including stress or moodiness, ease of anger, emotional unresponsiveness, and alertness and concentration, followed a pattern similar to

depression when analyzed by both biochemical and symptomatic iron deficiency indicators. In all cases, the presence of the select deficiency symptoms increased the correlation with these characteristics. Additionally, in all cases, the combination of anemia and the select deficiency symptoms resulted in the highest incidence of the characteristic. Moodiness and anger have been associated with low iron status throughout the literature, but the findings have been inconsistent (118, 121-123). A number of human studies have not found a statistically significant association between alertness and iron status, but to date none have used symptomatic measures of iron status to assess the correlation (109, 112). The presence of symptomatic measures of iron deficiency, such as dizziness and shortness of breath, indicate a level of iron deficiency that is causing physiological limitations, and may need to be present before affective and EF characteristics are evident.

As seen in Table 3-2, a number of other iron deficiency symptoms discussed in the literature were associated with anemia. IDA had a statistically significant correlation with self-reported impaired thyroid function, and the link between thyroid function and IDA is well established in the literature in both animal studies and human controlled trials (130). It has been shown that rats that have IDA have significantly lower circulating triiodothyronine (T3) and thyroxine (T4) than iron sufficient controls when exposed to cold (131, 176). Similarly, IDA and iron sufficient women have similar circulating T3 and T4, but when exposed to cold these biomarkers are markedly lower in the IDA women (133). It is largely accepted that because thyroid peroxidase, an enzyme critical in thyroid metabolism, contains heme, low iron decreases its function and thus results in lower thyroid hormone production (130). Our results agree with this work.

My results indicate an association between self-reported incidence of low blood sugar and anemia. A link between glucose homeostasis and iron deficiency has been suggested, but research is currently lacking. To date, animal models have indicated that iron is involved in the circadian rhythms of the liver that control glucose (136). More research on this topic is warranted.

Additionally, sleeping less than six hours each night was significantly correlated to anemia. The link between iron deficiency and sleep disturbance may be due to altered neurotransmitter signaling, but it may also have some association with restless leg syndrome (152, 153). Additionally, impaired sleep may worsen fatigue, and this association may represent an additional mechanism for fatigue as a common symptom of iron deficiency.

Obesity and iron deficiency is an area of recent interest. Observational data has been extremely inconsistent, but human trials have revealed decreased iron absorption in obesity (141, 142). In my study, anthropometric data for obesity, such as BMI and body composition, were not related to iron status, consistent with other studies (141, 177, 178).

This study has notable limitations. First, it is correlative in nature. Further studies will be necessary to determine whether iron deficiency is causative for the symptoms and signs discussed. Except as determined from ferritin status, the majority of subjects were iron sufficient, so the analysis of anemia, ID, and IDNA involved a small number of subjects. Additionally, numbers of subjects self-reporting dizziness and shortness of breath were also few, resulting in small numbers for this analysis. Due to funding constraints, measures of inflammation, namely CRP and AGP, were not completed, which prevents direct evidence of the impact of inflammation on the biochemical

measures of iron status. It must be noted, however, that a low ferritin status always indicates deficiency, as inflammation elevates ferritin values. Because the vast majority of ferritin values are low, inflammation likely had a minimal impact. Although obesity induces a low grade inflammatory state, no relationship was noted between ferritin and BMI values, suggesting that the obesity-induced inflammation had little to no effect on serum ferritin.

A number of symptoms ascribed to iron deficiency are disputed. Further, the value of certain biochemical measures of iron status are debated, as are the cutoff values for accepted measures of iron status. Due to physiological variation, it may be that biochemical measures alone may not be consistently predictive of iron deficiency symptoms. The addition of symptomatic measures of iron deficiency, such as dizziness and shortness of breath, improved the predictability of other affective and EF characteristics in my study. More and larger studies are warranted, using a combination of biochemical and symptomatic measures of iron status to assess correlation. Causation could be tested through controlled trials of iron supplementation against placebo for subjects experiencing these select deficiency symptoms to assess depression and other characteristics. Iron deficiency's potentially causative role in the presentation of these depressive and mood altering states may further explain their increased incidence in females and may provide a low-cost, targeted treatment for this population.

References

1. Andrews NC. Disorders of iron metabolism. N Engl J Med 1999 Dec 23;341:1986-95.

2. Cook JD, Barry WE, Hershko C, Fillet G, Finch CA. Iron kinetics with emphasis on iron overload. Am J Pathol 1973 Aug;72:337-44.

3. Mladenka P, Hrdina R, Hubl M, Simunek T. The fate of iron in the organism and its regulatory pathways. Acta Medica (Hradec Kralove) 2005;48:127-35.

4. Donovan A, Andrews NC. The molecular regulation of iron metabolism. Hematol J 2004;5:373-80.

5. Gulec S, Anderson GJ, Collins JF. Mechanistic and regulatory aspects of intestinal iron absorption. Am J Physiol Gastrointest Liver Physiol 2014 Aug 15;307:G397-409.

6. Heath AL, Fairweather-Tait SJ. Clinical implications of changes in the modern diet: iron intake, absorption and status. Best Pract Res Clin Haematol 2002 Jun;15:225-41.

7. Shayeghi M, Latunde-Dada GO, Oakhill JS, Laftah AH, Takeuchi K, Halliday N, Khan Y, Warley A, McCann FE, et al. Identification of an intestinal heme transporter. Cell 2005 Sep 9;122:789-801.

8. Wyllie JC, Kaufman N. An electron microscopic study of heme uptake by rat duodenum. Lab Invest 1982 Nov;47:471-6.

9. Parmley RT, Barton JC, Conrad ME, Austin RL, Holland RM. Ultrastructural cytochemistry and radioautography of hemoglobin--iron absorption. Exp Mol Pathol 1981 Apr;34:131-44.

10. Grasbeck R, Majuri R, Kouvonen I, Tenhunen R. Spectral and other studies on the intestinal haem receptor of the pig. Biochim Biophys Acta 1982 Jan 18;700:137-42.

11. Noyer CM, Immenschuh S, Liem HH, Muller-Eberhard U, Wolkoff AW. Initial heme uptake from albumin by short-term cultured rat hepatocytes is mediated by a transport mechanism differing from that of other organic anions. Hepatology 1998 Jul;28:150-5.

12. Qiu A, Jansen M, Sakaris A, Min SH, Chattopadhyay S, Tsai E, Sandoval C, Zhao R, Akabas MH, Goldman ID. Identification of an intestinal folate transporter and the molecular basis for hereditary folate malabsorption. Cell 2006 Dec 1;127:917-28.

13. Le Blanc S, Garrick MD, Arredondo M. Heme carrier protein 1 transports heme and is involved in heme-Fe metabolism. Am J Physiol Cell Physiol 2012 Jun 15;302:C1780-5.

14. McKie AT, Barrow D, Latunde-Dada GO, Rolfs A, Sager G, Mudaly E, Mudaly M, Richardson C, Barlow D, et al. An iron-regulated ferric reductase associated with the absorption of dietary iron. Science 2001 Mar 2;291:1755-9.

15. Gunshin H, Mackenzie B, Berger UV, Gunshin Y, Romero MF, Boron WF, Nussberger S, Gollan JL, Hediger MA. Cloning and characterization of a mammalian proton-coupled metal-ion transporter. Nature 1997 Jul 31;388:482-8.

16. Gunshin H, Starr CN, Direnzo C, Fleming MD, Jin J, Greer EL, Sellers VM, Galica SM, Andrews NC. Cybrd1 (duodenal cytochrome b) is not necessary for dietary iron absorption in mice. Blood 2005 Oct 15;106:2879-83.

17. Blanco E, Kannengiesser C, Grandchamp B, Tasso M, Beaumont C. Not all DMT1 mutations lead to iron overload. Blood Cells Mol Dis 2009 Sep-Oct;43:199-201.

18. Burgess L, Hackett AF, Kirby S, Maxwell S, Nathan I. A reassessment of the fat intake of children from meat and meat products and an estimate of haem iron intakes. J Hum Nutr Diet 2001 Feb;14:55-61.

19. Hallberg L, Brune M, Rossander L. Effect of ascorbic acid on iron absorption from different types of meals. Studies with ascorbic-acid-rich foods and synthetic ascorbic acid given in different amounts with different meals. Hum Nutr Appl Nutr 1986 Apr;40:97-113.

20. Hallberg L, Rossander L. Absorption of iron from Western-type lunch and dinner meals. Am J Clin Nutr 1982 Mar;35:502-9.

21. Hallberg L, Brune M, Rossander-Hulthen L. Is there a physiological role of vitamin C in iron absorption? Ann N Y Acad Sci 1987;498:324-32.

22. Cook JD, Watson SS, Simpson KM, Lipschitz DA, Skikne BS. The effect of high ascorbic acid supplementation on body iron stores. Blood 1984 Sep;64:721-6.

23. Malone HE, Kevany JP, Scott JM, O'Broin SD, O'Connor G. Ascorbic acid supplementation: its effects on body iron stores and white blood cells. Ir J Med Sci 1986 Mar;155:74-9.

24. Layrisse M, Martinez-Torres C, Roche M. Effect of interaction of various foods on iron absorption. Am J Clin Nutr 1968 Oct;21:1175-83.

25. Armah CN, Sharp P, Mellon FA, Pariagh S, Lund EK, Dainty JR, Teucher B, Fairweather-Tait SJ. L-alpha-glycerophosphocholine contributes to meat's enhancement of nonheme iron absorption. J Nutr 2008 May;138:873-7.

26. Hallberg L, Hulthen L. Prediction of dietary iron absorption: an algorithm for calculating absorption and bioavailability of dietary iron. Am J Clin Nutr 2000 May;71:1147-60.

27. Manach C, Scalbert A, Morand C, Remesy C, Jimenez L. Polyphenols: food sources and bioavailability. Am J Clin Nutr 2004 May;79:727-47.

28. Brune M, Rossander L, Hallberg L. Iron absorption and phenolic compounds: importance of different phenolic structures. Eur J Clin Nutr 1989 Aug;43:547-57.

29. Tuntawiroon M, Sritongkul N, Brune M, Rossander-Hulten L, Pleehachinda R, Suwanik R, Hallberg L. Dose-dependent inhibitory effect of phenolic compounds in foods on nonheme-iron absorption in men. Am J Clin Nutr 1991 Feb;53:554-7.

30. Hallberg L, Rossander L, Skanberg AB. Phytates and the inhibitory effect of bran on iron absorption in man. Am J Clin Nutr 1987 May;45:988-96.

31. Preziosi P, Hercberg S, Galan P, Devanlay M, Cherouvrier F, Dupin H. Iron status of a healthy French population: factors determining biochemical markers. Ann Nutr Metab 1994;38:192-202.

32. Galan P, Hercberg S, Soustre Y, Dop MC, Dupin H. Factors affecting iron stores in French female students. Hum Nutr Clin Nutr 1985 Jul;39:279-87.

33. Monsen ER, Cook JD. Food iron absorption in human subjects. IV. The effects of calcium and phosphate salts on the absorption of nonheme iron. Am J Clin Nutr 1976 Oct;29:1142-8.

34. Cook JD, Dassenko SA, Whittaker P. Calcium supplementation: effect on iron absorption. Am J Clin Nutr 1991 Jan;53:106-11.

35. Reddy MB, Cook JD. Effect of calcium intake on nonheme-iron absorption from a complete diet. Am J Clin Nutr 1997 Jun;65:1820-5.

36. Hallberg L, Brune M, Erlandsson M, Sandberg AS, Rossander-Hulten L. Calcium: effect of different amounts on nonheme- and heme-iron absorption in humans. Am J Clin Nutr 1991 Jan;53:112-9.

37. Hallberg L. Does calcium interfere with iron absorption? Am J Clin Nutr 1998 Jul;68:3-4.

38. Cook JD, Monsen ER. Food iron absorption in human subjects. III. Comparison of the effect of animal proteins on nonheme iron absorption. Am J Clin Nutr 1976 Aug;29:859-67.

39. Hallberg L, Rossander L. Effect of soy protein on nonheme iron absorption in man. Am J Clin Nutr 1982 Sep;36:514-20.

40. Morck TA, Lynch SR, Cook JD. Reduction of the soy-induced inhibition of nonheme iron absorption. Am J Clin Nutr 1982 Aug;36:219-28.

41. Donovan A, Lima CA, Pinkus JL, Pinkus GS, Zon LI, Robine S, Andrews NC. The iron exporter ferroportin/Slc40a1 is essential for iron homeostasis. Cell Metab 2005 Mar;1:191-200.

42. Aisen P, Wessling-Resnick M, Leibold EA. Iron metabolism. Curr Opin Chem Biol 1999 Apr;3:200-6.

43. Wright TL, Lake JR. Mechanisms of transport of nontransferrin-bound iron in basolateral and canalicular rat liver plasma membrane vesicles. Hepatology 1990 Sep;12:498-504.

44. Richardson DR. Mysteries of the transferrin-transferrin receptor 1 interaction uncovered. Cell 2004 Feb 20;116:483-5.

45. Radisky DC, Babcock MC, Kaplan J. The yeast frataxin homologue mediates mitochondrial iron efflux. Evidence for a mitochondrial iron cycle. J Biol Chem 1999 Feb 19;274:4497-9.

46. Douglas T, Ripoll DR. Calculated electrostatic gradients in recombinant human H-chain ferritin. Protein Sci 1998 May;7:1083-91.

47. Iancu TC. Ferritin and hemosiderin in pathological tissues. Electron Microsc Rev 1992;5:209-29.

48. Jacobs A, Worwood M. Ferritin in serum. Clinical and biochemical implications. N Engl J Med 1975 May 1;292:951-6.

49. Nemeth E, Tuttle MS, Powelson J, Vaughn MB, Donovan A, Ward DM, Ganz T, Kaplan J. Hepcidin regulates cellular iron efflux by binding to ferroportin and inducing its internalization. Science 2004 Dec 17;306:2090-3.

50. De Domenico I, Ward DM, Langelier C, Vaughn MB, Nemeth E, Sundquist WI, Ganz T, Musci G, Kaplan J. The molecular mechanism of hepcidin-mediated ferroportin down-regulation. Mol Biol Cell 2007 Jul;18:2569-78.

51. Nicolas G, Bennoun M, Porteu A, Mativet S, Beaumont C, Grandchamp B, Sirito M, Sawadogo M, Kahn A, Vaulont S. Severe iron deficiency anemia in transgenic mice expressing liver hepcidin. Proc Natl Acad Sci U S A 2002 Apr 2;99:4596-601.

52. Hentze MW, Kuhn LC. Molecular control of vertebrate iron metabolism: mRNA-based regulatory circuits operated by iron, nitric oxide, and oxidative stress. Proc Natl Acad Sci U S A 1996 Aug 6;93:8175-82.

53. Brown NM, Kennedy MC, Antholine WE, Eisenstein RS, Walden WE. Detection of a [3Fe-4S] cluster intermediate of cytosolic aconitase in yeast expressing iron regulatory protein 1. Insights into the mechanism of Fe-S cluster cycling. J Biol Chem 2002 Mar 1;277:7246-54.

54. Takahashi-Makise N, Ward DM, Kaplan J. On the mechanism of iron sensing by IRP2: new players, new paradigms. Nat Chem Biol 2009 Dec;5:874-5.

55. Cancado RD, Langhi D. Blood donation, blood supply, iron deficiency and anemia - it is time to shift attention back to donor health. Rev Bras Hematol Hemoter 2012;34:330-1.

56. Seidelman J, Zuo R, Udayakumar K, Gellad ZF. Caught on Capsule: Iron-deficiency Anemia Due to Hookworm Infection. Am J Med 2016 Feb;129:167-9.

57. Nair GV, Cazorla E, Choque H, White AC, Cabada MM. [Massive hookworm infection as a cause of intestinal bleeding and severe anemia]. Rev Gastroenterol Peru 2016 Jan-Mar;36:90-2.

58. Hotez PJ, Beaumier CM, Gillespie PM, Strych U, Hayward T, Bottazzi ME. Advancing a vaccine to prevent hookworm disease and anemia. Vaccine 2016 Jun 3;34:3001-5.

59. Bronstein AC, Spyker DA, Cantilena LR, Jr., Green JL, Rumack BH, Giffin SL. 2008 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 26th Annual Report. Clin Toxicol (Phila) 2009 Dec;47:911-1084.

60. Zimmermann MB, Hurrell RF. Nutritional iron deficiency. Lancet 2007 Aug 11;370:511-20.

61. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R, Regan M, Weatherall D, Chou DP, et al. A systematic analysis of global anemia burden from 1990 to 2010. Blood 2014 Jan 30;123:615-24.

62. McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. Public Health Nutr 2009 Apr;12:444-54.

63. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, Pena-Rosas JP, Bhutta ZA, Ezzati M, Nutrition Impact Model Study G. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: a systematic analysis of population-representative data. Lancet Glob Health 2013 Jul;1:e16-25.

64. Lopez A, Cacoub P, Macdougall IC, Peyrin-Biroulet L. Iron deficiency anaemia. Lancet 2016 Feb 27;387:907-16.

65. Gupta PM, Perrine CG, Mei Z, Scanlon KS. Iron, Anemia, and Iron Deficiency Anemia among Young Children in the United States. Nutrients 2016;8.

66. Cogswell ME, Looker AC, Pfeiffer CM, Cook JD, Lacher DA, Beard JL, Lynch SR, Grummer-Strawn LM. Assessment of iron deficiency in US preschool children and nonpregnant females of childbearing age: National Health and Nutrition Examination Survey 2003-2006. Am J Clin Nutr 2009 May;89:1334-42.

67. Recommendations to prevent and control iron deficiency in the United States. Centers for Disease Control and Prevention. MMWR Recomm Rep 1998 Apr 3;47:1-29.

68. Duport N, Preziosi P, Boutron-Ruault MC, Bertrais S, Galan P, Favier A, Lafond JL, Hercberg S. Consequences of iron depletion on health in menstruating women. Eur J Clin Nutr 2003 Sep;57:1169-75.

69. Ferguson C, Dickey W. Gastrointestinal investigation of iron deficiency anaemia detected by pre-blood donation screening. Scand J Gastroenterol 2007 Nov;42:1386-7.

70. Popovsky MA. Anemia, iron depletion, and the blood donor: it's time to work on the donor's behalf. Transfusion 2012 Apr;52:688-92.

71. Peyrin-Biroulet L, Williet N, Cacoub P. Guidelines on the diagnosis and treatment of iron deficiency across indications: a systematic review. Am J Clin Nutr 2015 Dec;102:1585-94.

72. Cook JD, Finch CA. Assessing iron status of a population. Am J Clin Nutr 1979 Oct;32:2115-9.

73. Greig AJ, Patterson AJ, Collins CE, Chalmers KA. Iron deficiency, cognition, mental health and fatigue in women of childbearing age: a systematic review. J Nutr Sci 2013;2:e14.

74. Wieringa FT, Dijkhuizen MA, West CE, Northrop-Clewes CA, Muhilal. Estimation of the effect of the acute phase response on indicators of micronutrient status in Indonesian infants. J Nutr 2002 Oct;132:3061-6.

75. Sauberlich HE, Dowdy RP, Skala JH. Laboratory tests for the assessment of nutritional status. CRC Crit Rev Clin Lab Sci 1973 Sep;4:215-340.

76. Beaton GH, Corey PN, Steele C. Conceptual and methodological issues regarding the epidemiology of iron deficiency and their implications for studies of the functional consequences of iron deficiency. Am J Clin Nutr 1989 Sep;50:575-85; discussion 86-8.

77. Hamilton LD, Gubler CJ, Cartwright GE, Wintrobe MM. Diurnal variation in the plasma iron level of man. Proc Soc Exp Biol Med 1950 Oct;75:65-8.

78. Hallberg L, Bengtsson C, Lapidus L, Lindstedt G, Lundberg PA, Hulten L. Screening for iron deficiency: an analysis based on bone-marrow examinations and serum ferritin determinations in a population sample of women. Br J Haematol 1993 Dec;85:787-98.

79. Wish JB. Assessing iron status: beyond serum ferritin and transferrin saturation. Clin J Am Soc Nephrol 2006 Sep;1 Suppl 1:S4-8.

80. Beerenhout C, Bekers O, Kooman JP, van der Sande FM, Leunissen KM. A comparison between the soluble transferrin receptor, transferrin saturation and serum ferritin as markers of iron state in hemodialysis patients. Nephron 2002 Sep;92:32-5.

81. Fernandez-Rodriguez AM, Guindeo-Casasus MC, Molero-Labarta T, Dominguez-Cabrera C, Hortal-Casc n L, Perez-Borges P, Vega-Diaz N, Saavedra-Santana P, Palop-Cubillo L. Diagnosis of iron deficiency in chronic renal failure. Am J Kidney Dis 1999 Sep;34:508-13.

82. Lee EJ, Oh EJ, Park YJ, Lee HK, Kim BK. Soluble transferrin receptor (sTfR), ferritin, and sTfR/log ferritin index in anemic patients with nonhematologic malignancy and chronic inflammation. Clin Chem 2002 Jul;48:1118-21.

83. Aydingoz IE, Ferhanoglu B, Guney O. Does tissue iron status have a role in female alopecia? J Eur Acad Dermatol Venereol 1999 Jul;13:65-7.

84. Esfandiarpour I, Farajzadeh S, Abbaszadeh M. Evaluation of serum iron and ferritin levels in alopecia areata. Dermatol Online J 2008;14:21.

85. Vanderford DA, Greer PK, Sharp JM, Chichlowski M, Rouse DC, Selim MA, Hale LP. Alopecia in IL-10-deficient mouse pups is c-kit-dependent and can be triggered by iron deficiency. Exp Dermatol 2010 Jun;19:518-26.

86. Lai JS, Cella D, Chang CH, Bode RK, Heinemann AW. Item banking to improve, shorten and computerize self-reported fatigue: an illustration of steps to create a core item bank from the FACIT-Fatigue Scale. Qual Life Res 2003 Aug;12:485-501.

87. Bager P. Fatigue and acute/chronic anaemia. Dan Med J 2014 Apr;61:B4824.

88. Hjollund NH, Andersen JH, Bech P. Assessment of fatigue in chronic disease: a bibliographic study of fatigue measurement scales. Health Qual Life Outcomes 2007;5:12.

89. Glaus A, Crow R, Hammond S. A qualitative study to explore the concept of fatigue/tiredness in cancer patients and in healthy individuals. Eur J Cancer Care (Engl) 1996 Jun;5:8-23.

90. Beutler E, Larsh SE, Gurney CW. Iron therapy in chronically fatigued, nonanemic women: a double-blind study. Ann Intern Med 1960 Feb;52:378-94.

91. Verdon F, Burnand B, Stubi CL, Bonard C, Graff M, Michaud A, Bischoff T, de Vevey M, Studer JP, et al. Iron supplementation for unexplained fatigue in non-anaemic women: double blind randomised placebo controlled trial. BMJ 2003 May 24;326:1124.

92. Gardner GW, Edgerton VR, Senewiratne B, Barnard RJ, Ohira Y. Physical work capacity and metabolic stress in subjects with iron deficiency anemia. Am J Clin Nutr 1977 Jun;30:910-7.

93. Murray-Kolb LE, Beard JL, Joseph LJ, Davey SL, Evans WJ, Campbell WW. Resistance training affects iron status in older men and women. Int J Sport Nutr Exerc Metab 2001 Sep;11:287-98.

94. Rajaram S, Weaver CM, Lyle RM, Sedlock DA, Martin B, Templin TJ, Beard JL, Percival SS. Effects of long-term moderate exercise on iron status in young women. Med Sci Sports Exerc 1995 Aug;27:1105-10.

95. Magnusson B, Hallberg L, Rossander L, Swolin B. Iron metabolism and "sports anemia". I. A study of several iron parameters in elite runners with differences in iron status. Acta Med Scand 1984;216:149-55.

96. Magnusson B, Hallberg L, Rossander L, Swolin B. Iron metabolism and "sports anemia". II. A hematological comparison of elite runners and control subjects. Acta Med Scand 1984;216:157-64.

97. Brownlie Tt, Utermohlen V, Hinton PS, Giordano C, Haas JD. Marginal iron deficiency without anemia impairs aerobic adaptation among previously untrained women. Am J Clin Nutr 2002 Apr;75:734-42.

98. Wood MM, Elwood PC. Symptoms of iron deficiency anaemia. A community survey. Br J Prev Soc Med 1966 Jul;20:117-21.

99. Lumish RA, Young SL, Lee S, Cooper E, Pressman E, Guillet R, O'Brien KO. Gestational iron deficiency is associated with pica behaviors in adolescents. J Nutr 2014 Oct;144:1533-9.

100. Walker SP, Wachs TD, Gardner JM, Lozoff B, Wasserman GA, Pollitt E, Carter JA, International Child Development Steering G. Child development: risk factors for adverse outcomes in developing countries. Lancet 2007 Jan 13;369:145-57.

101. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B, International Child Development Steering G. Developmental potential in the first 5 years for children in developing countries. Lancet 2007 Jan 6;369:60-70.

102. Murray-Kolb LE. Iron and brain functions. Curr Opin Clin Nutr Metab Care 2013 Nov;16:703-7.

103. Leonard AJ, Chalmers KA, Collins CE, Patterson AJ. A study of the effects of latent iron deficiency on measures of cognition: a pilot randomised controlled trial of iron supplementation in young women. Nutrients 2014 Jun;6:2419-35.

104. Algarin C, Nelson CA, Peirano P, Westerlund A, Reyes S, Lozoff B. Iron-deficiency anemia in infancy and poorer cognitive inhibitory control at age 10 years. Dev Med Child Neurol 2013 May;55:453-8.

105. Congdon EL, Westerlund A, Algarin CR, Peirano PD, Gregas M, Lozoff B, Nelson CA. Iron deficiency in infancy is associated with altered neural correlates of recognition memory at 10 years. J Pediatr 2012 Jun;160:1027-33.

106. Aoki S, Okada Y, Nishimura K, Barkovich AJ, Kjos BO, Brasch RC, Norman D. Normal deposition of brain iron in childhood and adolescence: MR imaging at 1.5 T. Radiology 1989 Aug;172:381-5.

107. Roskams AJ, Connor JR. Iron, transferrin, and ferritin in the rat brain during development and aging. J Neurochem 1994 Aug;63:709-16.

108. Pinero DJ, Li NQ, Connor JR, Beard JL. Variations in dietary iron alter brain iron metabolism in developing rats. J Nutr 2000 Feb;130:254-63.

109. Scott SP, Murray-Kolb LE. Iron Status Is Associated with Performance on Executive Functioning Tasks in Nonanemic Young Women. J Nutr 2016 Jan;146:30-7.

110. Izquierdo I. Dopamine receptors in the caudate nucleus and memory processes. Trends Pharmacol Sci 1992 Jan;13:7-8.

111. McClung JP, Murray-Kolb LE. Iron nutrition and premenopausal women: effects of poor iron status on physical and neuropsychological performance. Annu Rev Nutr 2013;33:271-88.

112. Blanton CA, Green MW, Kretsch MJ. Body iron is associated with cognitive executive planning function in college women. Br J Nutr 2013 Mar 14;109:906-13.

113. Beard JL, Hendricks MK, Perez EM, Murray-Kolb LE, Berg A, Vernon-Feagans L, Irlam J, Isaacs W, Sive A, Tomlinson M. Maternal iron deficiency anemia affects postpartum emotions and cognition. J Nutr 2005 Feb;135:267-72.

114. Murray-Kolb LE, Beard JL. Iron treatment normalizes cognitive functioning in young women. Am J Clin Nutr 2007 Mar;85:778-87.

115. Khedr E, Hamed SA, Elbeih E, El-Shereef H, Ahmad Y, Ahmed S. Iron states and cognitive abilities in young adults: neuropsychological and neurophysiological assessment. Eur Arch Psychiatry Clin Neurosci 2008 Dec;258:489-96.

116. Blanton C. Improvements in iron status and cognitive function in young women consuming beef or non-beef lunches. Nutrients 2014 Jan;6:90-110.

117. Bruner AB, Joffe A, Duggan AK, Casella JF, Brandt J. Randomised study of cognitive effects of iron supplementation in non-anaemic iron-deficient adolescent girls. Lancet 1996 Oct 12;348:992-6.

118. Elwood PC, Hughes D. Clinical trial of iron therapy of psychomotor function in anaemic women. Br Med J 1970 Aug 1;3:254-5.

119. Groner JA, Holtzman NA, Charney E, Mellits ED. A randomized trial of oral iron on tests of short-term memory and attention span in young pregnant women. J Adolesc Health Care 1986 Jan;7:44-8.

120. Kretsch MJ, Fong AK, Green MW, Johnson HL. Cognitive function, iron status, and hemoglobin concentration in obese dieting women. Eur J Clin Nutr 1998 Jul;52:512-8.

121. Sawada T, Konomi A, Yokoi K. Iron deficiency without anemia is associated with anger and fatigue in young Japanese women. Biol Trace Elem Res 2014 Jun;159:22-31.

122. Risser WL, Lee EJ, Poindexter HB, West MS, Pivarnik JM, Risser JM, Hickson JF. Iron deficiency in female athletes: its prevalence and impact on performance. Med Sci Sports Exerc 1988 Apr;20:116-21.

123. McClung JP, Karl JP, Cable SJ, Williams KW, Nindl BC, Young AJ, Lieberman HR. Randomized, double-blind, placebo-controlled trial of iron supplementation in female soldiers during military training: effects on iron status, physical performance, and mood. Am J Clin Nutr 2009 Jul;90:124-31.

124. Corwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin level is a risk factor for postpartum depression. J Nutr 2003 Dec;133:4139-42.

125. Albacar G, Sans T, Martin-Santos R, Garcia-Esteve L, Guillamat R, Sanjuan J, Canellas F, Gratacos M, Cavalle P, et al. An association between plasma ferritin concentrations measured 48 h after delivery and postpartum depression. J Affect Disord 2011 Jun;131:136-42.

126. Hercberg S, Galan P, Preziosi P, Roussel AM, Arnaud J, Richard MJ, Malvy D, Paul-Dauphin A, Briancon S, Favier A. Background and rationale behind the SU.VI.MAX Study, a prevention trial using nutritional doses of a combination of antioxidant vitamins and minerals to reduce cardiovascular diseases and cancers. SUpplementation en VItamines et Mineraux AntioXydants Study. Int J Vitam Nutr Res 1998;68:3-20.

127. Yi S, Nanri A, Poudel-Tandukar K, Nonaka D, Matsushita Y, Hori A, Mizoue T. Association between serum ferritin concentrations and depressive symptoms in Japanese municipal employees. Psychiatry Res 2011 Oct 30;189:368-72.

128. Vahdat Shariatpanaahi M, Vahdat Shariatpanaahi Z, Moshtaaghi M, Shahbaazi SH, Abadi A. The relationship between depression and serum ferritin level. Eur J Clin Nutr 2007 Apr;61:532-5.

129. Ando K, Morita S, Higashi T, Fukuhara S, Watanabe S, Park J, Kikuchi M, Kawano K, Wasada I, Hotta T. Health-related quality of life among Japanese women with iron-deficiency anemia. Qual Life Res 2006 Dec;15:1559-63.

130. Zimmermann MB. The influence of iron status on iodine utilization and thyroid function. Annu Rev Nutr 2006;26:367-89.

131. Beard J, Finch CA, Green WL. Interactions of iron deficiency, anemia, and thyroid hormone levels in response of rats to cold exposure. Life Sci 1982 Feb 15-22;30:691-7.

132. Tang F, Wong TM, Loh TT. Effects of cold exposure or TRH on the serum TSH levels in the iron-deficient rat. Horm Metab Res 1988 Oct;20:616-9.

133. Lukaski HC, Hall CB, Nielsen FH. Thermogenesis and thermoregulatory function of iron-deficient women without anemia. Aviat Space Environ Med 1990 Oct;61:913-20.

134. Hale LP, Kant EP, Greer PK, Foster WM. Iron supplementation decreases severity of allergic inflammation in murine lung. PLoS One 2012;7:e45667.

135. Brigham EP, McCormack MC, Takemoto CM, Matsui EC. Iron status is associated with asthma and lung function in US women. PLoS One 2015;10:e0117545.

136. Simcox JA, Mitchell TC, Gao Y, Just SF, Cooksey R, Cox J, Ajioka R, Jones D, Lee SH, et al. Dietary iron controls circadian hepatic glucose metabolism through heme synthesis. Diabetes 2015 Apr;64:1108-19.

137. Sinha N, Mishra TK, Singh T, Gupta N. Effect of iron deficiency anemia on hemoglobin A1c levels. Ann Lab Med 2012 Jan;32:17-22.

138. Coban E, Ozdogan M, Timuragaoglu A. Effect of iron deficiency anemia on the levels of hemoglobin A1c in nondiabetic patients. Acta Haematol 2004;112:126-8.

139. Pham NM, Nanri A, Yi S, Kurotani K, Akter S, Foo LH, Nishi N, Sato M, Hayabuchi H, Mizoue T. Serum ferritin is associated with markers of insulin resistance in Japanese men but not in women. Metabolism 2013 Apr;62:561-7.

140. Leiva E, Mujica V, Sepulveda P, Guzman L, Nunez S, Orrego R, Palomo I, Andrews M, Arredondo MA. High levels of iron status and oxidative stress in patients with metabolic syndrome. Biol Trace Elem Res 2013 Jan;151:1-8.

141. Mujica-Coopman MF, Brito A, Lopez de Romana D, Pizarro F, Olivares M. Body mass index, iron absorption and iron status in childbearing age women. J Trace Elem Med Biol 2015 Apr;30:215-9.

142. Cepeda-Lopez AC, Melse-Boonstra A, Zimmermann MB, Herter-Aeberli I. In overweight and obese women, dietary iron absorption is reduced and the enhancement of iron absorption by ascorbic acid is one-half that in normal-weight women. Am J Clin Nutr 2015 Dec;102:1389-97.

143. McClung JP, Karl JP. Iron deficiency and obesity: the contribution of inflammation and diminished iron absorption. Nutr Rev 2009 Feb;67:100-4.

144. Karl JP, Lieberman HR, Cable SJ, Williams KW, Glickman EL, Young AJ, McClung JP. Poor iron status is not associated with overweight or overfat in non-obese pre-menopausal women. J Am Coll Nutr 2009 Feb;28:37-42.

145. Gao Y, Li Z, Gabrielsen JS, Simcox JA, Lee SH, Jones D, Cooksey B, Stoddard G, Cefalu WT, McClain DA. Adipocyte iron regulates leptin and food intake. J Clin Invest 2015 Sep;125:3681-91.

146. Li R, Chen X, Yan H, Deurenberg P, Garby L, Hautvast JG. Functional consequences of iron supplementation in iron-deficient female cotton mill workers in Beijing, China. Am J Clin Nutr 1994 Apr;59:908-13.

147. Gershwin ME, Keen CL, Mareschi JP, Fletcher MP. Trace metal nutrition and the immune response. Compr Ther 1991 Mar;17:27-34.

148. Srikantia SG, Prasad JS, Bhaskaram C, Krishnamachari KA. Anaemia and immune response. Lancet 1976 Jun 19;1:1307-9.

149. Joynson DH, Walker DM, Jacobs A, Dolby AE. Defect of cell-mediated immunity in patients with iron-deficiency anaemia. Lancet 1972 Nov 18;2:1058-9.

150. Lo B. The requirement of iron transport for lymphocyte function. Nat Genet 2016 Jan;48:10-1.

151. Baghbanian M, Farahat A, Vahedian HA, Sheyda E, Zare-Khormizi MR. The Prevalence of Celiac Disease in Patients with Iron-Deficiency Anemia in Center and South Area of Iran. Arq Gastroenterol 2015 Dec;52:278-82.

152. Allen RP. Restless Leg Syndrome/Willis-Ekbom Disease Pathophysiology. Sleep Med Clin 2015 Sep;10:207-14, xi.

153. Richards KC, Bost JE, Rogers VE, Hutchison LC, Beck CK, Bliwise DL, Kovach CR, Cuellar N, Allen RP. Diagnostic accuracy of behavioral, activity, ferritin, and clinical indicators of restless legs syndrome. Sleep 2015 Mar;38:371-80.

154. Hallberg L, Rossander-Hulten L. Iron requirements in menstruating women. Am J Clin Nutr 1991 Dec;54:1047-58.

155. Armah SM, Carriquiry AL, Reddy MB. Total Iron Bioavailability from the US Diet Is Lower Than the Current Estimate. J Nutr 2015 Nov;145:2617-21.

156. Patterson AJ, Brown WJ, Roberts DC, Seldon MR. Dietary treatment of iron deficiency in women of childbearing age. Am J Clin Nutr 2001 Nov;74:650-6.

157. Bregman DB, Morris D, Koch TA, He A, Goodnough LT. Hepcidin levels predict nonresponsiveness to oral iron therapy in patients with iron deficiency anemia. Am J Hematol 2013 Feb;88:97-101.

158. Depression: The Treatment and Management of Depression in Adults (Updated Edition). Leicester (UK); 2010.

159. Lewinsohn PM, Solomon A, Seeley JR, Zeiss A. Clinical implications of "subthreshold" depressive symptoms. J Abnorm Psychol 2000 May;109:345-51.

160. Waraich P, Goldner EM, Somers JM, Hsu L. Prevalence and incidence studies of mood disorders: a systematic review of the literature. Can J Psychiatry 2004 Feb;49:124-38.

161. Fava M, Kendler KS. Major depressive disorder. Neuron 2000 Nov;28:335-41.

162. Nolen-Hoeksema S. Sex differences in unipolar depression: evidence and theory. Psychol Bull 1987 Mar;101:259-82.

163. Angst J, Merikangas K. The depressive spectrum: diagnostic classification and course. J Affect Disord 1997 Aug;45:31-9; discussion 9-40.

164. Angold A, Costello EJ, Worthman CM. Puberty and depression: the roles of age, pubertal status and pubertal timing. Psychol Med 1998 Jan;28:51-61.

165. Kessler RC. Epidemiology of women and depression. J Affect Disord 2003 Mar;74:5-13.

166. Runeson BS, Rich CL. Diagnostic and statistical manual of mental disorders, 3rd ed. (DSM-III), adaptive functioning in young Swedish suicides. Ann Clin Psychiatry 1994 Sep;6:181-3.

167. Prime-MD & PHQ Family of Scales Reference List by Author. 2010.

168. Kurt Kroenke M, Robert L. Splitzer, MD, Janet B. W. Williams, DSW. The PHQ-9: Validity of a Brief Depression Severity Measure. J Gen Intern Med 2001:606-13.

169. Eaton WW, Kessler LG. Rates of symptoms of depression in a national sample. Am J Epidemiol 1981 Oct;114:528-38.

170. Thurnham DI, McCabe LD, Haldar S, Wieringa FT, Northrop-Clewes CA, McCabe GP. Adjusting plasma ferritin concentrations to remove the effects of subclinical

inflammation in the assessment of iron deficiency: a meta-analysis. Am J Clin Nutr 2010 Sep;92:546-55.

171. Siek G, Lawlor J, Pelczar D, Sane M, Musto J. Direct serum total iron-binding capacity assay suitable for automated analyzers. Clin Chem 2002 Jan;48:161-6.

172. Gallagher CM, Chen JJ, Kovach JS. The relationship between body iron stores and blood and urine cadmium concentrations in US never-smoking, non-pregnant women aged 20-49 years. Environ Res 2011 Jul;111:702-7.

173. Huebers HA, Finch CA. The physiology of transferrin and transferrin receptors. Physiol Rev 1987 Apr;67:520-82.

174. Mojtabai R. Increase in antidepressant medication in the US adult population between 1990 and 2003. Psychother Psychosom 2008;77:83-92.

175. Bozoky I, Corwin EJ. Fatigue as a predictor of postpartum depression. J Obstet Gynecol Neonatal Nurs 2002 Jul-Aug;31:436-43.

176. Eftekhari MH, Eshraghian MR, Mozaffari-Khosravi H, Saadat N, Shidfar F. Effect of iron repletion and correction of iron deficiency on thyroid function in iron-deficient Iranian adolescent girls. Pak J Biol Sci 2007 Jan 15;10:255-60.

177. Kordas K, Fonseca Centeno ZY, Pachon H, Jimenez Soto AZ. Being overweight or obese is associated with lower prevalence of anemia among Colombian women of reproductive age. J Nutr 2013 Feb;143:175-81.

178. Wendt AS, Jefferds ME, Perrine CG, Halleslevens P, Sullivan KM. Obese women less likely to have low serum ferritin, Nicaragua. Public Health Nutr 2015 Mar;18:736-41.

Appendix A: Survey

Iron Deficiency and Vitamin D Deficiency in Female State Fair Attendees

Q57 Welcome to the Iron Deficiency and Vitamin D Deficiency survey! Please answer each question by either selecting the most accurate bullet point or filling in the text box. If desired, select the "Choose not to answer" option instead of leaving a question blank. If any confusion arises, please ask for assistance. Thank you!

Q100 Please enter your 3-digit code below:

Q2 Rate your overall health:

- ❍ Poor (1)
- ❍ Fair (2)
- ❍ Good (3)
- ❍ Excellent (4)

Q4 Over the last two weeks, how often have you been bothered by the following problems?

	Not At All (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Little interest or pleasure in doing things (1)	❍	❍	❍	❍	❍	❍
Feeling down, depressed, or hopeless (2)	❍	❍	❍	❍	❍	❍
Trouble falling or staying asleep, or sleeping too much (3)	❍	❍	❍	❍	❍	❍
Feeling tired or having little energy (4)	❍	❍	❍	❍	❍	❍
Poor appetite or overeating (5)	❍	❍	❍	❍	❍	❍
Feeling bad about yourself -- or that you are a failure or have let yourself or your family down (6)	❍	❍	❍	❍	❍	❍
Trouble concentrating on things, such as reading the news or watching television (7)	❍	❍	❍	❍	❍	❍
Moving or speaking either so quickly or so	❍	❍	❍	❍	❍	❍

slowly that other people may have noticed (8)						
Thoughts that you would be better off dead or of hurting yourself in some way (9)	❍	❍	❍	❍	❍	❍

Q5 In the last month, how often have you experienced any of the following problems?

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Fatigue or exhaustion (1)	❍	❍	❍	❍	❍	❍
Dizziness (2)	❍	❍	❍	❍	❍	❍
Shortness of breath (3)	❍	❍	❍	❍	❍	❍
Decreased work ability (4)	❍	❍	❍	❍	❍	❍
More tired after eating (5)	❍	❍	❍	❍	❍	❍
Restless Leg Syndrome (6)	❍	❍	❍	❍	❍	❍
Headaches (7)	❍	❍	❍	❍	❍	❍
Migraines (8)	❍	❍	❍	❍	❍	❍
Increased fatigue with more sleep (9)	❍	❍	❍	❍	❍	❍
Racing thoughts that prevent sleep (10)	❍	❍	❍	❍	❍	❍

Q8 For the following two questions, please indicate how often you have experienced the following over the last month:

Q6 MEMORY AND LEARNING

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Decreased short-term memory (1)	❍	❍	❍	❍	❍	❍
Decreased long-term memory (2)	❍	❍	❍	❍	❍	❍
Decreased alertness/concentration (3)	❍	❍	❍	❍	❍	❍
ADHD / ADD tendencies (4)	❍	❍	❍	❍	❍	❍
Poor or decreased math ability (5)	❍	❍	❍	❍	❍	❍
Bumping into things more than normal (6)	❍	❍	❍	❍	❍	❍

Q7 EMOTION

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Feel sad (1)	❍	❍	❍	❍	❍	❍
Cry easily (2)	❍	❍	❍	❍	❍	❍
Easy to anger (3)	❍	❍	❍	❍	❍	❍
Stressed and/or moody (4)	❍	❍	❍	❍	❍	❍
Obsessive/compulsive tendencies (5)	❍	❍	❍	❍	❍	❍
Feel emotionally unresponsive (6)	❍	❍	❍	❍	❍	❍

Q12 For the next six questions, please indicate whether or not you have experienced the following over the last month by checking all that apply. If no choice applies, check "None are applicable."

Q9 SKIN

- ❑ Pale complexion (1)
- ❑ Palms that are more orange in color than pink (2)
- ❑ Acne or skin changes (3)
- ❑ Bruise easily (4)
- ❑ Heal slowly (5)
- ❑ Cracks at lip corners (6)
- ❑ Psoriasis or Eczema (7)
- ❑ Other skin problems (8)
- ❑ None are applicable (9)
- ❑ Choose not to answer (10)

Q10 NAILS

- ❑ Spooned or flat (1)
- ❑ Soft/weak (2)
- ❑ White lines (3)
- ❑ White nails (4)
- ❑ Ridged (5)
- ❑ Hangnails (6)
- ❑ Dark pink (7)
- ❑ None are applicable (8)
- ❑ Choose not to answer (9)

Q11 HAIR

- ❑ Hair thinning (1)
- ❑ Lots of hair in brush or shower (2)
- ❑ Hair graying (3)
- ❑ None are applicable (4)
- ❑ Choose not to answer (5)

Q13 EYES

- ❑ Dry/Itchy eyes (1)
- ❑ I wear contact lenses (2)
- ❑ Poor night time vision (3)
- ❑ None are applicable (4)
- ❑ Choose not to answer (5)

Q14 TEMPERATURE

- ❑ Cold when others are not (1)
- ❑ Hot when others are not (2)
- ❑ None are applicable (3)
- ❑ Choose not to answer (4)

Q15 MISCELLANEOUS

- ❑ Heartburn symptoms or GERD (1)
- ❑ H-pylori (2)
- ❑ Gall bladder problems (3)
- ❑ Kidney problems (4)
- ❑ Hemorrhoids (5)
- ❑ Frequent or urgent urination (6)
- ❑ High blood pressure (7)
- ❑ Urinary tract infection (8)
- ❑ Asthma like symptoms (9)
- ❑ Allergies (10)
- ❑ Other (please describe): (11) _____
- ❑ None are applicable (12)
- ❑ Choose not to answer (13)

Q16 Indicate conditions you have experienced in the last month:

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Nausea (1)	❍	❍	❍	❍	❍	❍
Vomiting (2)	❍	❍	❍	❍	❍	❍
Constipation (3)	❍	❍	❍	❍	❍	❍
Diarrhea (4)	❍	❍	❍	❍	❍	❍
Low blood sugar (5)	❍	❍	❍	❍	❍	❍

Q17 How many times a week do you have bowel movements?

- ❍ Daily (1)
- ❍ 4-6 times a week (2)
- ❍ 2-3 times a week (3)
- ❍ Once a week (4)
- ❍ Less than once a week (5)
- ❍ Choose not to answer (6)

Q18 Do you take medications for the following conditions?

	Not at all (1)	Occasionally (2)	Several days a week (3)	More than half the days a week (4)	Nearly every day (5)	Choose not to answer (6)
ADHD/ADD (1)	❍	❍	❍	❍	❍	❍
Allergy (2)	❍	❍	❍	❍	❍	❍
Anti-anxiety (3)	❍	❍	❍	❍	❍	❍
Antidepressants (4)	❍	❍	❍	❍	❍	❍
Blood pressure (5)	❍	❍	❍	❍	❍	❍
Cholesterol lowering medication (6)	❍	❍	❍	❍	❍	❍
Diabetes medication (7)	❍	❍	❍	❍	❍	❍
Thyroid (8)	❍	❍	❍	❍	❍	❍
Monoamine inhibitor (9)	❍	❍	❍	❍	❍	❍
GERD (esophageal reflux) (10)	❍	❍	❍	❍	❍	❍
Other (please describe) (11)	❍	❍	❍	❍	❍	❍

Q19 BLOOD DONATIONS

Q20 I have been turned away from donating blood.
- Yes (1)
- No (2)
- Don't know (3)
- Choose not to answer (4)

Display This Question:
If I have been turned away from donating blood. Yes Is Selected

Q21 I was turned away _____ months ago.

Display This Question:
If I have been turned away from donating blood. Yes Is Selected

Q22 The reason for being turned away from donating was:

Q23 How many times in your life have you donated blood?
- Indicate the number of times by typing a number. If you have never donated blood, enter 0 (1) _____
- Choose not to answer (2)

Display This Question:
If How many times in your life have you donated blood? Indicate the number of times by typing a number. If you have never donated blood, enter 0 Is Not Equal to 0

Q24 Last time I donated blood was _____ months ago.
- Indicated the number of months ago: (1) _____
- Choose not to answer (2)

Q25 Indicate if you are experiencing any of these health-related conditions:

	Yes (1)	No (2)	Don't know (3)	Choose not to answer (4)
Anemia or were marginally anemic (1)	❍	❍	❍	❍
Iron deficient (2)	❍	❍	❍	❍
Sickle cell anemia or thalassemia (3)	❍	❍	❍	❍
Hemochromatosis (4)	❍	❍	❍	❍
High cholesterol (5)	❍	❍	❍	❍
High triglycerides (6)	❍	❍	❍	❍
Impaired liver or hepatitis (7)	❍	❍	❍	❍
Thyroid condition (8)	❍	❍	❍	❍

Q26 How do you classify your current eating style? Indicate all that apply

	Yes (1)	No (2)	Don't know (3)	Choose not to answer (4)
Omnivore (eats all types of food including meat) (1)	❍	❍	❍	❍
Does not eat red meat (2)	❍	❍	❍	❍
Vegan (no animal products) (3)	❍	❍	❍	❍
Vegetarian (with egg) (4)	❍	❍	❍	❍
Vegetarian (with milk products) (5)	❍	❍	❍	❍
Vegetarian (with fish) (6)	❍	❍	❍	❍
Functional Vegetarian (most of the time) (7)	❍	❍	❍	❍
Healthy Eater (8)	❍	❍	❍	❍
Organic foods (9)	❍	❍	❍	❍
Natural foods (10)	❍	❍	❍	❍
Picky eater (11)	❍	❍	❍	❍

Q27 Do you have any other food allergies?

- ❍ Yes (please list): (1) _____
- ❍ No (2)
- ❍ Choose not to answer (3)

Q28 In the previous week, have you experienced any of the following (indicate all that apply):

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Frequent starving sensation (1)	❍	❍	❍	❍	❍	❍
Sweet tooth (crave sugar or fruit) (2)	❍	❍	❍	❍	❍	❍
Crave chocolate (3)	❍	❍	❍	❍	❍	❍
Crave carbohydrates (4)	❍	❍	❍	❍	❍	❍
Crave salt (5)	❍	❍	❍	❍	❍	❍
Frequently or always thirsty (6)	❍	❍	❍	❍	❍	❍
Ice chewing (7)	❍	❍	❍	❍	❍	❍
Picky eater (8)	❍	❍	❍	❍	❍	❍
Food aversions (please describe) (9)	❍	❍	❍	❍	❍	❍
Lactose intolerance (10)	❍	❍	❍	❍	❍	❍
Gluten intolerance (11)	❍	❍	❍	❍	❍	❍
Food allergy (12)	❍	❍	❍	❍	❍	❍

Q30 Have you recently experienced any of the following related to your weight or body fat?

	Yes (1)	No (2)	Don't know (3)	Choose not to answer (4)
Losing weight (1)	❍	❍	❍	❍
Gaining weight (2)	❍	❍	❍	❍
Gaining fat (3)	❍	❍	❍	❍
Increased waistline fat (4)	❍	❍	❍	❍
Can't lose weight-even with dieting and exercise regimen (5)	❍	❍	❍	❍

Q31 Please answer the following questions about your eating patterns:

	Not at all (1)	Occasionally (2)	Several days (3)	More than half the days (4)	Nearly every day (5)	Choose not to answer (6)
Do you typically skip breakfast? (1)	❍	❍	❍	❍	❍	❍
Do you eat only a low fat diet? (2)	❍	❍	❍	❍	❍	❍
Do you eat a high fiber diet? (3)	❍	❍	❍	❍	❍	❍
Do you count the calories you eat? (4)	❍	❍	❍	❍	❍	❍
Do you use a weight tracker App? (5)	❍	❍	❍	❍	❍	❍
Do you use an exercise App? (6)	❍	❍	❍	❍	❍	❍

Q32 How many calories do you aim to consume in a typical day?

- Enter number of calories: (1) _____
- Choose not to answer (2)

Q33 How many steps do you walk per day?

- Enter number of steps: (1) _____
- Choose not to answer (2)

Q34 How many hours per night do you sleep?

- Enter number of hours: (1) _____
- Choose not to answer (2)

Q35 How many minutes per day do you exercise?

- Enter number of minutes: (1) _____
- Choose not to answer (2)

Q36 For the following questions, please indicate how many days you consumed the following over the last week:

Q37 ANIMAL PROTEIN SOURCES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Beef or lamb (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Chicken or turkey breast (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Chicken thigh (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Pork (not including bacon) (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Egg (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other (please describe) (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q38 SEAFOOD SOURCES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Fish (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Shellfish (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Shrimp (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Red clam (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other (please describe) (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q39 PLANT PROTEIN SOURCES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Beans (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Nuts or nut butter (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Tofu (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Vegetarian patty (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Protein powder (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Protein bars (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other (please describe) (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q40 DAIRY SOURCES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Yogurt (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Cottage cheese (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Cheddar, jack, mozzarella or other cheese (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q41 FRUITS AND VEGETABLES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Berries (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Citrus (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other fruit (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Carrots (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Spinach (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Leafy greens (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other vegetables (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Potatoes (in some form) (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q42 BEVERAGES

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
Water (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Fruit juice (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Calcium fortified orange juice (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Milk or chocolate milk (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Soy milk (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Rice or almond milk (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Calcium fortified soy, rice, or almond milk (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Tea (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Coffee (9)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Energy drinks (10)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Red wine (11)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other alcohol (12)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Sodas with sugar (13)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Sugar free beverages (14)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Other (please describe) (15)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q43 GRAIN PRODUCTS

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Don't know (9)	Choose not to answer (10)
Whole grain bread and cereal products (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Enriched grain products (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Gluten-free grain products (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Corn grain bread products (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other grain products (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Iron fortified cereals (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Calcium fortified cereals (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other (please describe) (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q44 DIETARY SUPPLEMENTS AND HERBAL PRODUCTS

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	Choose not to answer (9)
An iron supplement or prenatal (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Multi-vitamin with iron (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Vitamin B12 (separate from multi) (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Vitamin C (separate from multi) (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Calcium supplement (separate from multi) (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Supplement with Vitamin D (separate from multi) (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Fish oil (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other (please list) (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q45 Do you have or experience:

	Yes (1)	No (2)	Don't know (3)	Choose not to answer (4)
PMS (1)	❍	❍	❍	❍
Polycystic Ovarian Syndrome (PCOS) (2)	❍	❍	❍	❍
A birth control pill that contains iron? (3)	❍	❍	❍	❍
A birth control agent that decreases the number or heaviness of your blood flow (4)	❍	❍	❍	❍

Q47 Over the last 6 months, how frequently does your period occur?

- ❍ Once every 2-3 months (1)
- ❍ Monthly (2)
- ❍ More than monthly (3)
- ❍ Other (please describe) (4) _____
- ❍ Choose not to answer (5)

Q48 Over the last 6 months, blood flow is

- ❍ Heavy (1)
- ❍ Normal (2)
- ❍ Light (3)
- ❍ Choose not to answer (4)

Q49 The first day of your last period was _____

- ❍ Enter date here: (1) _____
- ❍ Choose not to answer (2)

Q102 Your eye color is:

- ❍ Light blue, light gray, or light green (1)
- ❍ Blue, gray, or green (2)
- ❍ Hazel or light brown (3)
- ❍ Dark brown (4)
- ❍ Brownish black (5)

Q103 Your natural hair color is:
- ❍ Red or light blonde (1)
- ❍ Blonde (2)
- ❍ Dark blonde or light brown (3)
- ❍ Dark brown (4)
- ❍ Black (5)

Q104 Your natural skin color (before sun exposure) is:
- ❍ Ivory white (1)
- ❍ Fair or pale (2)
- ❍ Fair to beige, with golden undertones (3)
- ❍ Olive or light brown (4)
- ❍ Dark brown or black (5)

Q105 How many freckles do you have on unexposed areas of your skin?
- ❍ Many (1)
- ❍ Several (2)
- ❍ A few (3)
- ❍ Very few (4)
- ❍ None (5)

Q106 How does your skin respond to the sun?
- ❍ Always burns, blisters, and peels (1)
- ❍ Often burns, blisters, and peels (2)
- ❍ Burns moderately (3)
- ❍ Burns rarely, if at all (4)
- ❍ Never burns (5)

Q107 Does your skin tan?
- ❍ Never, I always burn (1)
- ❍ Seldom (2)
- ❍ Sometimes (3)
- ❍ Often (4)
- ❍ Always (5)

Q108 How deeply do you tan?
- ❍ Not at all or very little (1)
- ❍ Lightly (2)
- ❍ Moderately (3)
- ❍ Deeply (4)
- ❍ My skin is naturally dark (5)

Q109 How sensitive is your face to the sun?

- ❍ Very sensitive (1)
- ❍ Sensitive (2)
- ❍ Normal (3)
- ❍ Resistant (4)
- ❍ Very resistant or never had a problem (5)

Appendix B: SAS Data

```
data all_data     (label = 'Survey,iron status, and biometric
measures')
no_antidep (label='Survey, iron status, and biometric measures without
people
taking antidepressants');

Title2 'Survey, iron status, and biometric measures analysis';
Input V8     SCO_1 Q100  Q2    Q4_1  Q4_2  Q4_3  Q4_4  Q4_5  Q4_6  Q4_7
Q4_8  Q4_9  Q5_1  Q5_2  Q5_3  Q5_4  Q5_5  Q5_6
Q5_7  Q5_8  Q5_9  Q5_10 Q6_1  Q6_2  Q6_3  Q6_4  Q6_5  Q6_6  Q7_1
Q7_2  Q7_3  Q7_4  Q7_5  Q7_6  Q9    Q10   Q11   Q13   Q14
Q15   Q16_1 Q16_2 Q16_3 Q16_4 Q16_5 Q17   Q18_1 Q18_2 Q18_3 Q18_4 Q18_5
Q18_6 Q18_7 Q18_8 Q18_9 Q18_10      Q18_11      Q18_11_TEXT
Q20   Q21   Q22   Q23_TEXT    Q24_TEXT    Q25_1 Q25_2 Q25_3 Q25_4 Q25_5
      Q25_6
Q25_7 Q25_8 Q26_1 Q26_2 Q26_3 Q26_4 Q26_5 Q26_6
Q26_7 Q26_8 Q26_9 Q26_10      Q26_11      Q27   Q27_TEXT    Q28_1 Q28_2
      Q28_3 Q28_4
Q28_5 Q28_6 Q28_7 Q28_8 Q28_9 Q28_9_TEXT  Q28_10
Q28_11      Q28_12      Q30_1 Q30_2 Q30_3 Q30_4 Q30_5 Q31_1 Q31_2 Q31_3
      Q31_4
Q31_5 Q31_6 Q32_TEXT    Q33_TEXT    Q34_TEXT    Q35_TEXT
Q37_1 Q37_2 Q37_3 Q37_4 Q37_5 Q37_6 Q37_6_TEXT  Q38_1 Q38_2 Q38_3
Q38_4 Q38_5 Q39_1 Q39_2 Q39_3 Q39_4 Q39_5 Q39_6
Q39_7 Q40_1 Q40_2 Q40_3 Q41_1 Q41_2 Q41_3 Q41_4 Q41_5 Q41_6 Q41_7
Q41_8 Q42_1 Q42_2 Q42_3 Q42_4 Q42_5 Q42_6
Q42_7 Q42_8 Q42_9 Q42_10      Q42_11      Q42_12      Q42_13
      Q42_14      Q42_15      Q43_1 Q43_2
Q43_3 Q43_4 Q43_5 Q43_6 Q43_7 Q43_8 Q44_1
Q44_2 Q44_3 Q44_4 Q44_5 Q44_6 Q44_7 Q44_8 Q44_8_TEXT  Q45_1 Q45_2
Q45_3 Q45_4 Q47   Q47_TEXT    Q48   Q_49_TEXT   Hct   Hb    Ferritin
age
systolic_BP diastolic_BP height weight body_fat_percent BMI TIBC
;

label
V8='Collection Date'
SCO_1='Fizpatrick Skin Type'
Q100='Participant Code'
Q2='Health Rating'
PHQ9='Depression Screen Score'
Fe_Def_Score='Iron deficiency symptoms Score'
Q4_1='Little interest or pleasure doing things'
Q4_2='Feeling down, depressed, or hopeless'
Q4_3='Trouble falling, staying asleep'
Q4_4='Feeling tired or having little energy'
Q4_5='Poor apetite or overeating'
Q4_6='Feeling bad about yourself'
Q4_7='Trouble concentrating'
Q4_8='Moving or speaking quickly or slowly'
Q4_9='Thoughts better off dead hurting yourself'
Q5_1='Last month - experienced fatigue'
Q5_2='Last month - dizziness'
Q5_3='Last month - Shortness of breath'
Q5_4='Last month - Decreased work ability'
```

```
Q5_5='Last month - more tired after eating'
Q5_6='Last month - Restless Leg Syndrome'
Q5_7='Last month - headaches'
Q5_8='Last month - migraines'
Q5_9='Last month - Increased fatigue with more sleep'
Q5_10='Last month - Racing thoughts that prevent sleep'
ferritin='plasma ferritin (ng/mL)'
Hct='hematocrit (%)'
Hb='hemoglobin (g/dL)'
Fe_Def_symptom_Score='Sum of iron deficiency symptoms'
Q6_1= 'decreased short term memory'
Q6_2= 'decreased long term memory'
Q6_3= 'decreased alertness/concentration'
Q6_4= 'ADD/ADHD tendencies'
Q6_5= 'poor or decreased math ability'
Q6_6= 'bumping into things'
Q7_1= 'feel sad'
Q7_2= 'cry easily'
Q7_3= 'easy to anger'
Q7_4= 'stressed and/or moody'
Q7_5= 'OCD tendencies'
Q7_6= 'feel emotionally unresponsive'
Q9= 'skin complications score'
Q10= 'nail complications score'
Q11= 'hair complications score'
Q13= 'eye complications score'
Q14= 'temperature complications score'
Q15= 'misc complications score'
Q16_1= 'last month - nausea'
Q16_2= 'last month - vomiting'
Q16_3= 'last month - constipation'
Q16_4= 'last month - diarrhea'
Q16_5= 'last month - low blood sugar'
Q17= 'bowel movements per week'
Q18_1= 'medications - ADD/ADHD'
Q18_2= 'medications - allergy'
Q18_3= 'medications - anti-anxiety'
Q18_4= 'medications - anti-depressants'
Q18_5= 'medications - blood pressure'
Q18_6= 'medications - cholesterol'
Q18_7= 'medications - diabetes'
Q18_8= 'medications - thyroid'
Q18_9= 'medications - monoamine inhibitor'
Q18_10= 'medications - GERD'
Q18_11= 'medications - other'
Q18_11_TEXT= 'medications - other - describe'
Q20= 'turned away from donating blood'
Q21= 'turned away from donating blood X months ago'
Q22= 'reason turned away from donating blood'
Q23_TEXT= 'times donated blood'
Q24_TEXT= 'months ago last donated blood'
Q25_1= 'experiencing - anemia'
Q25_2= 'experiencing - iron deficiency'
Q25_3= 'experiencing - sickle cell anemia or thalassemia'
Q25_4= 'experiencing - hemochromotosis'
Q25_5= 'experiencing - high cholesterol'
Q25_6= 'experiencing - high triglycerides'
Q25_7= 'experiencing - liver impairment or hepatitis'
```

```
Q25_8= 'experiencing - thyroid condition'
Q26_1= 'eating style - ominivore'
Q26_2= 'eating style - no red meat'
Q26_3= 'eating style - vegan'
Q26_4= 'eating style - ovo-vegetarian'
Q26_5= 'eating style - lacto-vegetarian'
Q26_6= 'eating style - pescatarian'
Q26_7= 'eating style - functional vegetarian'
Q26_8= 'eating style - healthy eater'
Q26_9= 'eating style - organic foods'
Q26_10= 'eating style - natural foods'
Q26_11= 'eating style - picky eater'
Q27= 'have food allergies'
Q27_TEXT = 'list food allergies'
Q28_1= 'week - frequent starving sensation'
Q28_2= 'week - sweet tooth'
Q28_3= 'week - crave chocolate'
Q28_4= 'week - crave carbs'
Q28_5= 'week - crave salt'
Q28_6= 'week - frequently/always thirsty'
Q28_7= 'week - ice chewing'
Q28_8= 'week - picky eater'
Q28_9= 'week - food aversions'
Q28_9_TEXT= 'week - list food aversions'
Q28_10= 'week - lactose intolerance'
Q28_11= 'week - gluten intolerance'
Q28_12= 'week - food allergies'
Q30_1= 'recent - weight loss'
Q30_2= 'recent - weight gain'
Q30_3= 'recent - fat gain'
Q30_4= 'recent - increased waistline fat'
Q30_5= 'recent - inability to lose weight'
Q31_1= 'skip breakfast'
Q31_2= 'eat a low fat diet'
Q31_3= 'eat a high fiber diet'
Q31_4= 'count calories'
Q31_5= 'weight tracker app'
Q31_6= 'exercise app'
Q32_TEXT= 'calories/day'
Q33_TEXT= 'steps/day'
Q34_TEXT= 'hours sleep/night'
Q35_TEXT= 'minutes exercise/day'
Q37_1= 'animal protein - beef or lamb'
Q37_2= 'animal protein - chicken or turkey breast'
Q37_3= 'animal protein - chicken thigh'
Q37_4= 'animal protein - pork'
Q37_5= 'animal protein - egg'
Q37_6= 'animal protein - other'
Q37_6_TEXT= 'animal protein - other - describe'
Q38_1= 'seafood - fish'
Q18_2= 'seafood - shellfish'
Q38_3= 'seafood - shrimp'
Q38_4= 'seafood - red clam'
Q38_5= 'seafood - other - describe'
Q39_1= 'plant protein - beans'
Q39_2= 'plant protein - nuts/nut butter'
Q39_3= 'plant protein - tofu'
Q39_4= 'plant protein - vegetarian patty'
```

```
Q39_5= 'plant protein - protein powder'
Q39_6= 'plant protein - protein bars'
Q39_7= 'plant protein - other - desribe'
Q40_1= 'Dairy - yogurt'
Q40_2= 'Dairy - cottage cheese'
Q40_3= 'Dairy - cheese'
Q41_1= 'produce - berries'
Q41_2= 'produce - citrus'
Q41_3= 'produce - other fruit'
Q41_4= 'produce - carrots'
Q41_5= 'produce - spinach'
Q41_6= 'produce - leafy greens'
Q41_7= 'produce - other vegetables'
Q41_8= 'produce - potatoes'
Q42_1= 'water'
Q42_2= 'fruit juice'
Q42_3= 'Ca fortified OJ'
Q42_4= 'milk/chocolate milk'
Q42_5= 'soy milk'
Q42_6= 'rice/almond milk'
Q42_7= 'Ca fortified soy/rice/almond milk'
Q42_8= 'tea'
Q42_9= 'coffee'
Q42_10= 'energy drinks'
Q42_11= 'red wine'
Q42_12= 'other alcohol'
Q42_13= 'sugary soda'
Q42_14= 'sugar free drinks'
Q42_15= 'other drinks - describe'
Q43_1= 'grains - whole grains'
Q43_2= 'grains - enriched grains'
Q43_3= 'grains - gluten-free grains'
Q43_4= 'grains - corn grain bread products'
Q43_5= 'grains - other grain products'
Q43_6= 'grains - iron fortified cereals'
Q43_7= 'grains - Ca fortified cereals'
Q43_8= 'grains - other - describe'
Q44_1= 'supp - iron/prenatal'
Q44_2= 'supp - vitamin with iron'
Q44_3= 'supp - B12'
Q44_4= 'supp - C'
Q44_5= 'supp - Ca'
Q44_6= 'supp - D'
Q44_7= 'supp - fish oil'
Q44_8= 'supp - other'
Q44_8_TEXT= 'supp - other - describe'
Q45_1= 'have/experience - PMS'
Q45_2= 'have/experience - PCOS'
Q45_3= 'have/experience - birth control that contains iron'
Q45_4= 'have/experience - birth control that decreases periods'
Q47= 'frequency of period in last 6 months'
Q47_TEXT= 'frequency of period - other - describe'
Q48= 'blood flow in last 6 months'
Q_49_TEXT= 'number of days since last period'
Hct = 'hematocrit (%)'
Hb = 'hemoglobin (g/dL)'
ferritin = 'ferritin (ng/mL)'
age = 'age (years)'
```

```
BP = 'blood pressure (mm Hg)'
height = 'height (cm)'
weight = 'weight (kg)'
body_fat_percent = 'percent body fat'
BMI = 'BMI (kg/m^2)'
systolic_BP = 'systolic blood pressure (mm Hg)'
diastolic_BP = 'diastolic blood pressure (mm Hg)'
TIBC = 'TIBC (ug/dL)'
select_iron_def_symp_cutoff='dizziness, shortness breath, headaches
cutoff'
;

;



*DEPRESSION SCREEN - The PHQ9 - comes from Question 4 -
      Setting '0' to 'missing value';

if Q4_1=0 then Q4_1=.;
if Q4_2=0 then Q4_2=.;
if Q4_3=0 then Q4_3=.;
if Q4_4=0 then Q4_4=.;
if Q4_5=0 then Q4_5=.;
if Q4_6=0 then Q4_6=.;
if Q4_7=0 then Q4_7=.;
if Q4_8=0 then Q4_8=.;
if Q4_9=0 then Q4_9=.;

*Categorizing the PHQ9 scores.  This is updated, as at first there were
5
      categories, and now there are only 4;
if Q4_1=1 then Q4_1=0;
if Q4_2=1 then Q4_2=0;
if Q4_3=1 then Q4_3=0;
if Q4_4=1 then Q4_4=0;
if Q4_5=1 then Q4_5=0;
if Q4_6=1 then Q4_6=0;
if Q4_7=1 then Q4_7=0;
if Q4_8=1 then Q4_8=0;
if Q4_9=1 then Q4_9=0;

if Q4_1=2 then Q4_1=1;
if Q4_2=2 then Q4_2=1;
if Q4_3=2 then Q4_3=1;
if Q4_4=2 then Q4_4=1;
if Q4_5=2 then Q4_5=1;
if Q4_6=2 then Q4_6=1;
if Q4_7=2 then Q4_7=1;
if Q4_8=2 then Q4_8=1;
if Q4_9=2 then Q4_9=1;

if Q4_1=3 then Q4_1=1;
if Q4_2=3 then Q4_2=1;
if Q4_3=3 then Q4_3=1;
if Q4_4=3 then Q4_4=1;
if Q4_5=3 then Q4_5=1;
```

```
if Q4_6=3 then Q4_6=1;
if Q4_7=3 then Q4_7=1;
if Q4_8=3 then Q4_8=1;
if Q4_9=3 then Q4_9=1;

if Q4_1=4 then Q4_1=2;
if Q4_2=4 then Q4_2=2;
if Q4_3=4 then Q4_3=2;
if Q4_4=4 then Q4_4=2;
if Q4_5=4 then Q4_5=2;
if Q4_6=4 then Q4_6=2;
if Q4_7=4 then Q4_7=2;
if Q4_8=4 then Q4_8=2;
if Q4_9=4 then Q4_9=2;

if Q4_1=5 then Q4_1=3;
if Q4_2=5 then Q4_2=3;
if Q4_3=5 then Q4_3=3;
if Q4_4=5 then Q4_4=3;
if Q4_5=5 then Q4_5=3;
if Q4_6=5 then Q4_6=3;
if Q4_7=5 then Q4_7=3;
if Q4_8=5 then Q4_8=3;
if Q4_9=5 then Q4_9=3;

*Creation of a depression total--PHQ9 variable;
PHQ9= Q4_1+Q4_2+Q4_3+Q4_4+Q4_5+Q4_6+Q4_7+Q4_8+Q4_9;

*categorization of severity of depression;
If PHQ9=<4 then dep_severity=1;
if PHQ9=>5 AND PHQ9=<9 then dep_severity=2;
if PHQ9=>10 AND PHQ9=<14 then dep_severity=3;
if PHQ9=>15 AND PHQ9=<19 then dep_severity=4;
if PHQ9=>20 AND PHQ9=<27 then dep_severity=5;


*categorization of severity of depression in two categories;
 if dep_severity=<2 then dep_cutoff=1;
      else dep_cutoff=2;
```

```
*IRON DEFICIENCY SYMPTOMS - comes from Question 5 -
      Setting '0' to 'missing value';

if Q5_1=0 then Q5_1=.;
if Q5_2=0 then Q5_2=.;
if Q5_3=0 then Q5_3=.;
if Q5_4=0 then Q5_4=.;
if Q5_5=0 then Q5_5=.;
if Q5_6=0 then Q5_6=.;
if Q5_7=0 then Q5_7=.;
if Q5_8=0 then Q5_8=.;
if Q5_9=0 then Q5_9=.;
if Q5_10=0 then Q5_10=.;

*Creation of total iron deficiency symptom score from Q5;
Fe_Def_symptom_Score =
Q5_1+Q5_2+Q5_3+Q5_4+Q5_5+Q5_6+Q5_7+Q5_8+Q5_9+Q5_10;

*Creation of a symptom score that only includes the 6 that fit the
regression model;
important_symptoms_score= Q5_1+Q5_2+Q5_3+Q5_7+Q5_9+Q5_10;
*Categorization of important_symptoms_score so that I can make it a
cutoff and use it in
frequency tables-I did 2.5 times 6 = 15 as the cutoff.  This did not
make sense to use
with depression, as some of these symptoms are also symptoms of
depression;
if important_symptoms_score <=15 then func_iron_def_symp_cutoff=1;
if important_symptoms_score >15 then func_iron_def_symp_cutoff=2;
*Categorization of select_symptoms_score to make a cutoff for use in
frequency tables
- used 2.5 times 3 = 7.5.  Again, this did not make sense to use with
depression;
if select_symptoms_score <=7.5 then select_iron_def_symp_cutoff=1;
if select_symptoms_score >7.5 then select_iron_def_symp_cutoff=2;

*Creation of select iron deficiency symptoms score - symptoms that do
not overlap with
symptoms seen in depression=headaches, shortness of breath, dizziness;
select_symptoms_score=Q5_2+Q5_3+Q5_7;

*Creation of a select symptoms score without headaches (just SOB and
dizziness).  This is
the main variable used for depression analysis;
dizzy_SOB_score=Q5_2+Q5_3;
*Categorization of the new select score without headaches;
if dizzy_SOB_score <4 then dizzy_SOB_cutoff=1;
if dizzy_SOB_score >=4 then dizzy_SOB_cutoff=2;

*Creating cutoffs for individual questions within Q5;
*creation of a fatigue variable;
If q5_1=1 or q5_1=2 then fatigue=1;
else fatigue=2;
*creation of a variable for racing thoughts that prevent sleep;
if Q5_10=1 or Q5_10=2 then racing_thoughts=1;
else racing_thoughts=2;
*creation of a variable for dizziness;
if Q5_2=1 or Q5_2=2 then dizziness=1;
```

```
else dizziness=2;
*creation of a variable for increased fatigue with more sleep;
if Q5_9=1 or Q5_9=2 then fatigue_with_sleep=1;
else fatigue_with_sleep=2;
*creation of a variable for headaches;
if Q5_7=1 or Q5_7=2 then headaches=1;
else headaches=2;
*creation of a variable for shortness of breath;
if Q5_3=1 or Q5_3=2 then short_breath=1;
else short_breath=2;









*BIOCHEMICAL MARKERS
ANEMIA - Hematocrit and Hemoglobin;
*categorization of anemia based on hematocrit and hemoglobin cutoffs;
if Hct<38 OR HB<12 then iron_status=1;
      else iron_status=2;

*FERRITIN;
*categorization of Ferritin values;
if ferritin<=12 then ferritin_status=1;
if ferritin>12 AND ferritin<=20 then ferritin_status=2;
if ferritin>20 then ferritin_status=3;
*categorization of Ferritin values by cutoff;
if ferritin<=20 then ferritin_cutoff=1;
if ferritin>20 then ferritin_cutoff=2;

*TIBC;
*categorization of TIBC values by cutoff;
if TIBC<=400 then TIBC_cutoff=1;
 else TIBC_cutoff=2;

*COMBINATIONS OF IRON VALUES;
*IDNA - creation of a group that is ID but not anemic based on abnormal
measurements of both
ferritin and TIBC, as ID is usually classified as two or more abnormal
readings;
if ferritin_cutoff=1 AND TIBC_cutoff=2 AND iron_status=2 then
ID_no_anemia = 1;
if ferritin_cutoff=2 OR TIBC_cutoff=1 AND iron_status=2 then
ID_no_anemia =2;
```

```
*ID & ANEMIC - creation of a group that is ID and anemic--meaning they
have abnormal results
for all iron measures--and a group that has totally normal results for
all measures;
if ferritin_cutoff=1 AND TIBC_cutoff=2 AND iron_status=1 then
ID_and_anemia=1;
if ferritin_cutoff=2 AND TIBC_cutoff=2 AND iron_status=2 then
ID_and_anemia=2;

*ID - creation of a group that combines TIBC and ferritin without
regard to anemia;
if ferritin_cutoff=1 AND TIBC_cutoff=2 then ID=1;
      else ID=2;
```

```
*BIOCHEMICAL MARKERS WITH SYMPTOMS: SYMPTOMATIC IRON DEFICIENCY;
*Fatigue with biochemical markers;
*Anemia & fatigue - functional iron deficiency;
if iron_status=1 and fatigue=2 then function_def=1;
if iron_status=2 and fatigue=1 then function_def=2;

*ID & fatigue - creation of a group that combines TIBC, ferritin, and
fatigue;
if ferritin_cutoff=1 AND TIBC_cutoff=2 AND fatigue=2 then
TIBC_ferritin_fatigue=1;
if ferritin_cutoff=1 AND TIBC_cutoff=2 AND fatigue=1 then
TIBC_Ferritin_fatigue=2;
if ferritin_cutoff=2 OR TIBC_cutoff=1 AND fatigue=1 then
TIBC_Ferritin_fatigue=3;

if fatigue=2 and ID=2 then NIDYF=1;
if fatigue=2 and ID=1 then NIDYF=2;

if fatigue=2 and iron_status=2 then NAYF=1;
if fatigue=2 and iron_status=1 then NAYF=2;

if fatigue=1 and iron_status=1 then ANF=1;
if fatigue=1 and iron_status=2 then ANF=2;

*Dizziness, SOB, and Headaches with Biochemical markers
Anemia & 3 select symptoms
(iron_status=2 means NO anemia, iron_status=1 means anemia);
if select_iron_def_symp_cutoff=1 AND iron_status=2
```

```
then anemia_select_Fe_def_sym_cutoff=1;
if select_iron_def_symp_cutoff=1 AND iron_status=1
then anemia_select_Fe_def_sym_cutoff=2;
if select_iron_def_symp_cutoff=2 AND iron_status=2
then anemia_select_Fe_def_sym_cutoff=3;
if select_iron_def_symp_cutoff=2 AND iron_status=1
then anemia_select_Fe_def_sym_cutoff=4;

*Dizziness and SOB with biochemical markers
Anemia & 2 select symptoms;
if dizzy_SOB_cutoff=1 AND iron_status=2 then anemia_dizzy_SOB_cutoff=1;
if dizzy_SOB_cutoff=1 AND iron_status=1 then anemia_dizzy_SOB_cutoff=2;
if dizzy_SOB_cutoff=2 AND iron_status=2 then anemia_dizzy_SOB_cutoff=3;
if dizzy_SOB_cutoff=2 AND iron_status=1 then anemia_dizzy_SOB_cutoff=4;
```

```
*ANTHROPOMETRIC MEASURES;
*categorization of percent body fat;
if body_fat_percent <= 24 then PBF_status = 1;
if body_fat_percent => 25 AND body_fat_percent <= 31 then PBF_status =
2;
if body_fat_percent => 32 then PBF_status =3;

*categorization of BMI;
if BMI < 18.5 then BMI_status = 1;
if BMI => 18.5 AND BMI <=24.9 then BMI_status = 2;
if BMI => 25.0 AND BMI <=29.9 then BMI_status = 3;
if BMI => 30.0 then BMI_status = 4;
*making a BMI cutoff value;
if BMI_status =1 OR BMI_status=2 then BMI_cutoff=1;
if BMI_status =3 OR BMI_status=4 then BMI_cutoff=2;

*categorization of blood pressure;
if systolic_BP <=120 AND diastolic_BP <=80 then BP_status = 1;
if systolic_BP =>121 AND systolic_BP <=139 OR diastolic_BP => 81 and
diastolic_BP <=89
then BP_status = 2;
if systolic_BP =>140 OR diastolic_BP => 90 then BP_status =3;
```

```
*COGNITION
Executive Functioning - Q6 - Memory and Learning
Q6 setting 'choose not to answer' as missing value;
if Q6_1=0 then Q6_1=.;
if Q6_2=0 then Q6_2=.;
if Q6_3=0 then Q6_3=.;
if Q6_4=0 then Q6_4=.;
if Q6_5=0 then Q6_5=.;
if Q6_6=0 then Q6_6=.;
*Q6 setting 'not at all' as 0;
if Q6_1=1 then Q6_1=0;
if Q6_2=1 then Q6_2=0;
if Q6_3=1 then Q6_3=0;
if Q6_4=1 then Q6_4=0;
if Q6_5=1 then Q6_5=0;
if Q6_6=1 then Q6_6=0;
*Q6 sum and cutoff creation;
learning_quantification=Q6_1+Q6_2+Q6_3+Q6_4+Q6_5+Q6_6;
if learning_quantification=0 then learning_status=1;
else learning_status=2;

*setting variables to look at Executive Functioning more closely;
if Q6_1>=3 then short_memory=1;
      else short_memory=2;
if Q6_2>=3 then long_memory=1;
      else long_memory=2;
memory_sum=Q6_1+Q6_2;
if memory_sum>=6 then memory_cutoff=1;
else memory_cutoff=2;
if Q6_3>=3 then concentration=1;
      else concentration=2;
if Q6_4>=3 then ADD=1;
      else ADD=2;
if Q6_5>=3 then math_ability=1;
      else math_ability=2;
if Q6_6>=3 then bumping=1;
      else bumping=2;

*Affective characteristics - Q7 - Emotion
Q7 setting 'choose not to answer' as missing value;
if Q7_1=0 then Q7_1=.;
if Q7_2=0 then Q7_2=.;
if Q7_3=0 then Q7_3=.;
if Q7_4=0 then Q7_4=.;
if Q7_5=0 then Q7_5=.;
if Q7_6=0 then Q7_6=.;
*Q7 setting 'not at all' as 0;
if Q7_1=1 then Q7_1=0;
if Q7_2=1 then Q7_2=0;
```

```
if Q7_3=1 then Q7_3=0;
if Q7_4=1 then Q7_4=0;
if Q7_5=1 then Q7_5=0;
if Q7_6=1 then Q7_6=0;
*Summation and cutoff for Q7;
emotion_quantification=Q7_1+Q7_2+Q7_3+Q7_4+Q7_5+Q7_6;
if emotion_quantification <=12 then emotion_status=1;
else emotion_status=2;

*setting variables to look at affective characteristics;
if Q7_1>=3 then sad=1;
      else sad=2;
if Q7_2>=3 then cry=1;
      else cry=2;
if Q7_3>=3 then anger=1;
      else anger=2;
if Q7_4>=3 then moody=1;
      else moody=2;
if Q7_5>=3 then OCD=1;
      else OCD=2;
if Q7_6>=3 then unresponsive=1;
      else unresponsive=2;

*PHYSICAL SYMPTOMS - Q 9 - 15;
*setting 'choose not to answer' as '.' or 'missing value' for all the
      physical sypmtoms questions;
if Q9=9 then Q9=.;
if Q10=9 then Q10=.;
if Q11=9 then Q11=.;
if Q13=9 then Q13=.;
if Q14=9 then Q14=.;
if Q15=9 then Q15=.;

*setting cutoffs for the physical sypmtoms questions and then a
quantification and cutoff for physical symptoms;
if Q9>=3 then skin=1;
      else skin=2;
if Q10>=3 then nails=1;
      else nails=2;
if Q11>=2 then hair=1;
      else hair=2;
if Q13>=1 then eyes=1;
      else eyes=2;
if Q14>=1 then temperature=1;
      else temperature=2;
if Q15>=3 then misc=1;
      else misc=2;
physical_sum=q9+Q10+Q11+Q13+Q14+Q15;
if physical_sum>=12 then physical_cutoff=1;
      else physical_cutoff=2;

*HEALTH HISTORY;
*Q16  - conditions - 'choose not to answer' as '.' or 'missing value'
      and 'not at all' as '0';
if Q16_1=0 then Q16_1=.;
if Q16_2=0 then Q16_2=.;
if Q16_3=0 then Q16_3=.;
if Q16_4=0 then Q16_4=.;
```

```
if Q16_5=0 then Q16_5=.;
if Q16_1=1 then Q16_1=0;
if Q16_2=1 then Q16_2=0;
if Q16_3=1 then Q16_3=0;
if Q16_4=1 then Q16_4=0;
if Q16_5=1 then Q16_5=0;
*cutoffs for health conditions in the last month;
if Q16_1>=3 then nausea=1;
      else nausea=2;
if Q16_2>=3 then vomitting=1;
      else vomitting=2;
if Q16_3>=3 then constipation=1;
      else constipation=2;
if Q16_4>=3 then diarrhea=1;
      else diarrhea=2;
if Q16_5>=3 then low_sugar=1;
      else low_sugar=2;

*Q17 - BM - set 'choose not to answer' as 'missing value';
if Q17=6 then Q17=.;
*cutoff for BM;

if Q17<=2 then BM=1;
      else BM=2;

*Medication Q18 setting 'choose not to answer' as missing value;
if Q18_1=0 then Q18_1=.;
if Q18_2=0 then Q18_2=.;
if Q18_3=0 then Q18_3=.;
if Q18_4=0 then Q18_4=.;
if Q18_5=0 then Q18_5=.;
if Q18_6=0 then Q18_6=.;
if Q18_7=0 then Q18_7=.;
if Q18_8=0 then Q18_8=.;
if Q18_9=0 then Q18_9=.;
if Q18_10=0 then Q18_10=.;
if Q18_11=0 then Q18_11=.;

*medication Q18 setting 'not at all' as 0;
if Q18_1=1 then Q18_1=0;
if Q18_2=1 then Q18_2=0;
if Q18_3=1 then Q18_3=0;
if Q18_4=1 then Q18_4=0;
if Q18_5=1 then Q18_5=0;
if Q18_6=1 then Q18_6=0;
if Q18_7=1 then Q18_7=0;
if Q18_8=1 then Q18_8=0;
if Q18_9=1 then Q18_9=0;
if Q18_10=1 then Q18_10=0;
if Q18_11=1 then Q18_11=0;

*Creation of a cholesterol variable;
if Q18_6>=2 OR Q25_5=1 then cholesterol=1;
      else cholesterol=2;

*creation of a tryglyceride variable;
if Q26_6=1 then trigly=1;
      else trigly=2;
```

```
*Creation of a GERD variable;
if Q18_10>=2 then GERD=1;
      else GERD=2;

*Creation of a diabetes variable;
if Q18_7>=2 then diabetes=1;
      else diabetes=2;

*creation of a thyroid variable;
if Q18_8=>2 OR Q25_8=1 then thyroid=1;
      else thyroid=2;

*Dietary health symptoms/eating style - Q28;
*setting choose not to answer as missing value for Q28;
if Q28_1=0 then Q28_1=.;
if Q28_2=0 then Q28_2=.;
if Q28_3=0 then Q28_3=.;
if Q28_4=0 then Q28_4=.;
if Q28_5=0 then Q28_5=.;
if Q28_6=0 then Q28_6=.;
if Q28_7=0 then Q28_7=.;
if Q28_8=0 then Q28_8=.;
if Q28_9=0 then Q28_9=.;
if Q28_10=0 then Q28_10=.;
if Q28_11=0 then Q28_11=.;
if Q28_12=0 then Q28_12=.;
*setting 'not at all' as 0 for Q28;
if Q28_1=1 then Q28_1=0;
if Q28_2=1 then Q28_2=0;
if Q28_3=1 then Q28_3=0;
if Q28_4=1 then Q28_4=0;
if Q28_5=1 then Q28_5=0;
if Q28_6=1 then Q28_6=0;
if Q28_7=1 then Q28_7=0;
if Q28_8=1 then Q28_8=0;
if Q28_9=1 then Q28_9=0;
if Q28_10=1 then Q28_10=0;
if Q28_11=1 then Q28_11=0;
if Q28_12=1 then Q28_12=0;

*setting a variable for cravings;
cravings_sum=Q28_1+Q28_2+Q28_3+Q28_4+Q28_5+Q28_6+Q28_7;
*making a cutoff for this variable;
if cravings_sum>=21 then cravings_cutoff=1;
      else cravings_cutoff=2;

*setting a variable for food intolerances;
intolerances_sum=Q28_8+Q28_9+Q28_10+Q28_11+Q18_12;
*making a cutoff for this variable;
if intolerances_sum>=12 then intolerances_cutoff=1;
      else intolerances_sum=2;

*setting a variable for food cravings and intolerances sum (all of
Q28);
Q28_sum=cravings_sum+intolerances_sum;
*making a cutoff for this variable;
if Q28_sum>=33 then Q28_cutoff=1;
```

```
      else Q28_cutoff=2;

*Weight changes - Q30
setting a variable for weight changes - all of Q30;
if Q30_1=1 OR Q30_2=1 OR Q30_3=1 OR Q30_4=1 OR Q30_5=1 then
weight_change=1;
      else weight_change=2;
*looking more into Q30 because it was very significant for
      anemia+fatigue but not for anemia alone;
if Q30_1=1 then weight_loss=1;
      else weight_loss=2;
if Q30_2=1 then weight_gain=1;
      else weight_gain=2;
if Q30_3=1 then fat_gain=1;
      else fat_gain=2;
if Q30_4=1 then waist_fat=1;
      else waist_fat=2;
if Q30_5=1 then unable_weight_loss=1;
      else unable_weight_loss=2;

*Exercise - Q35
making a variable for exercise intensity;
if Q35_TEXT>=45 then exercise=1;
      else exercise=2;

*Sleep - Q34;
*making a variable for sleep;
if Q34_TEXT<6 then sleep=1;
      else sleep=2;

*DIET
Meat consumption;
*categorization of meat consumption status based on Q26;
if Q26_1=1 then meat_status=1;
if Q26_2=1 then meat_status=2;
if Q26_3=1 OR Q26_4=1 OR Q26_5=1 OR Q26_6=1 OR Q26_7=1 then
meat_status=3;
*setting choose not to answer as missing value for meat consumption;
if Q37_1=9 then Q37_1=.;
if Q37_2=9 then Q37_2=.;
if Q37_3=9 then Q37_3=.;
if Q37_4=9 then Q37_4=.;
if Q37_5=9 then Q37_5=.;
if Q37_6=9 then Q37_6=.;

*setting '0' as '0' for meat consumption Q37;
if Q37_1=1 then Q37_1=0;
if Q37_2=1 then Q37_2=0;
if Q37_3=1 then Q37_3=0;
if Q37_4=1 then Q37_4=0;
if Q37_5=1 then Q37_5=0;
if Q37_6=1 then Q37_6=0;

*categorization of meat consumption status based on Q37;
Meat_Quantification=Q37_1+Q37_2+Q37_3+Q37_4;
if Meat_Quantification=0 then meat_consumption=1;
if Meat_Quantification<=6 then meat_consumption=2;
else meat_consumption=3;
```

```
*setting 'choose not to answer' as missing value Q38 seafood;
if Q38_1=9 then Q38_1=.;
if Q38_2=9 then Q38_2=.;
if Q38_3=9 then Q38_3=.;
if Q38_4=9 then Q38_4=.;
if Q38_5=9 then Q38_5=.;

*setting '0' as '0' for Q38 seafood;
if Q38_1=1 then Q38_1=0;
if Q38_2=1 then Q38_2=0;
if Q38_3=1 then Q38_3=0;
if Q38_4=1 then Q38_4=0;
if Q38_5=1 then Q38_5=0;

*setting choose not to answer as missing value for Plant Protein Q39;
if Q39_1=9 then Q39_1=.;
if Q39_2=9 then Q39_2=.;
if Q39_3=9 then Q39_3=.;
if Q39_4=9 then Q39_4=.;
if Q39_5=9 then Q39_5=.;
if Q39_6=9 then Q39_6=.;
if Q39_7=9 then Q39_7=.;

*setting '0' as '0' for Plant Protein Q39;
if Q39_1=1 then Q39_1=0;
if Q39_2=1 then Q39_2=0;
if Q39_3=1 then Q39_3=0;
if Q39_4=1 then Q39_4=0;
if Q39_5=1 then Q39_5=0;
if Q39_6=1 then Q39_6=0;
if Q39_7=1 then Q39_7=0;

*Q40 Dairy set 'Choose not to answer' as '.';
if Q40_1=9 then Q40_1=.;
if Q40_2=9 then Q40_2=.;
if Q40_3=9 then Q40_3=.;

*Q40 Dairy set '0' as '0';
if Q40_1=1 then Q40_1=0;
if Q40_2=1 then Q40_2=0;
if Q40_3=1 then Q40_3=0;

*Q41 Fruits and veggies set 'Choose not to answer' as '.';
if Q41_1=9 then Q41_1=.;
if Q41_2=9 then Q41_2=.;
if Q41_3=9 then Q41_3=.;
if Q41_4=9 then Q41_4=.;
if Q41_5=9 then Q41_5=.;
if Q41_6=9 then Q41_6=.;
if Q41_7=9 then Q41_7=.;
if Q41_8=9 then Q41_8=.;

*Q41 Fruits and Veggies set '0' as '0';
if Q41_1=1 then Q41_1=0;
if Q41_2=1 then Q41_2=0;
if Q41_3=1 then Q41_3=0;
if Q41_4=1 then Q41_4=0;
```

```
if Q41_5=1 then Q41_5=0;
if Q41_6=1 then Q41_6=0;
if Q41_7=1 then Q41_7=0;
if Q41_8=1 then Q41_8=0;

*Q42 Beverages set 'Choose not to answer' as '.';
if Q42_1=9 then Q42_1=.;
if Q42_2=9 then Q42_2=.;
if Q42_3=9 then Q42_3=.;
if Q42_4=9 then Q42_4=.;
if Q42_5=9 then Q42_5=.;
if Q42_6=9 then Q42_6=.;
if Q42_7=9 then Q42_7=.;
if Q42_8=9 then Q42_8=.;
if Q42_9=9 then Q42_9=.;
if Q42_10=9 then Q42_10=.;
if Q42_11=9 then Q42_11=.;
if Q42_12=9 then Q42_12=.;
if Q42_13=9 then Q42_13=.;
if Q42_14=9 then Q42_14=.;
if Q42_15=9 then Q42_15=.;

*Q42 Beverages set '0' as '0';
if Q42_1=1 then Q42_1=0;
if Q42_2=1 then Q42_2=0;
if Q42_3=1 then Q42_3=0;
if Q42_4=1 then Q42_4=0;
if Q42_5=1 then Q42_5=0;
if Q42_6=1 then Q42_6=0;
if Q42_7=1 then Q42_7=0;
if Q42_8=1 then Q42_8=0;
if Q42_9=1 then Q42_9=0;
if Q42_10=1 then Q42_10=0;
if Q42_11=1 then Q42_11=0;
if Q42_12=1 then Q42_12=0;
if Q42_13=1 then Q42_13=0;
if Q42_14=1 then Q42_14=0;
if Q42_15=1 then Q42_15=0;

*Q43 Grains set 'Choose not to answer' as '.';
if Q43_1=9 then Q43_1=.;
if Q43_2=9 then Q43_2=.;
if Q43_3=9 then Q43_3=.;
if Q43_4=9 then Q43_4=.;
if Q43_5=9 then Q43_5=.;
if Q43_6=9 then Q43_6=.;
if Q43_7=9 then Q43_7=.;
if Q43_8=9 then Q43_8=.;

*Q43 Grains set '0' as '0';
if Q43_1=1 then Q43_1=0;
if Q43_2=1 then Q43_2=0;
if Q43_3=1 then Q43_3=0;
if Q43_4=1 then Q43_4=0;
if Q43_5=1 then Q43_5=0;
if Q43_6=1 then Q43_6=0;
if Q43_7=1 then Q43_7=0;
if Q43_8=1 then Q43_8=0;
```

```
*Q44 set 'Choose not to answer' as '.';
if Q44_1=9 then Q44_1=.;
if Q44_2=9 then Q44_2=.;
if Q44_3=9 then Q44_3=.;
if Q44_4=9 then Q44_4=.;
if Q44_5=9 then Q44_5=.;
if Q44_6=9 then Q44_6=.;
if Q44_7=9 then Q44_7=.;
if Q44_8=9 then Q44_8=.;

*Q44 Supplements set '0' as '0';
if Q44_1=1 then Q44_1=0;
if Q44_2=1 then Q44_2=0;
if Q44_3=1 then Q44_3=0;
if Q44_4=1 then Q44_4=0;
if Q44_5=1 then Q44_5=0;
if Q44_6=1 then Q44_6=0;
if Q44_7=1 then Q44_7=0;
if Q44_8=1 then Q44_8=0;

*making a variable for iron supplementation;
if Q44_1>=2 or Q44_2>=2 then supp=1;
      else supp=2;

*Iron Absorption Enhancers:
*making an ascorbic acid variable sum;
AA_sum=Q41_1+Q41_2+Q41_3+Q41_8+Q42_2+Q42_3+Q44_4;
*making an ascorbic acid variable cutoff--for all of the following
cutoffs,
if the person listed a food item as 0 or 1 times/week, then they had
little or no
consumptionof that item, so we multiplied the number of questions in
that category by 2.
For an extreme consumption, we made that as 5  6 or 7 times/week, so we
multiplied the
numberof questions in the category by 6;
if AA_sum<=14 then AA_cutoff=1;
if AA_sum>=42 then AA_cutoff=2;

*making a meat factor variable sum;
MF_sum=Q37_1+Q37_2+Q37_3+Q37_4+Q37_6+Q38_1+Q38_2+Q38_3+Q38_4+Q38_5;
*making a meat factor cutoff;
if MF_sum<=20 then MF_cutoff=1;
if MF_sum>=60 then MF_cutoff=2;

*making a variable for other alcohol (that is not red wine);
OA=Q42_12;
*making a variable for other alcohol by cutoff;
if OA<=2 then OA_cutoff=1;
if OA>=6 then OA_cutoff=2;

*making a variable for all iron absorption enhancers;
Enhancers_sum=AA_sum+MF_sum+OA;

*Iron Absorption Inhibitors
making a Polyphenol variable sum---I DON'T REALLY KNOW HOW TO ADD IN
THE PEOPLE
```

```
WHO PUT FLAX OIL (3) FOR OTHER MEDICATIONS (44_8_TEXT) HERE BUT IT IS A
FACTOR;
polyphenol_sum=Q41_1+Q41_2+Q41_3+Q41_4+Q42_2+Q42_3+Q42_8+Q42_9+Q42_11;
*making a polyphenol variable cutoff;
if polyphenol_sum<=18 then polyphenol_cutoff=1;
if polyphenol_sum>=54 then polyphenol_cutoff=2;

*making a calcium variable sum;
calcium_sum=Q40_1+Q40_2+Q40_3+Q42_3+Q42_4+Q42_7+Q43_7+Q44_5;
*making a calcium variable by cutoff;
if calcium_sum<=16 then calcium_cutoff=1;
if calcium_sum>=48 then calcium_cutoff=2;

*making a soy variable sum;
soy_sum=Q39_3+Q39_4+Q39_5+Q39_6+Q42_5;
*making a soy variable cutoff;
if soy_sum<=10 then soy_cutoff=1;
if soy_sum>=30 then soy_cutoff=2;

*making an egg variable;
egg=Q37_5;
*making an egg variable cutoff;
if egg<=2 then egg_cutoff=1;
if egg>=6 then egg_cutoff=2;

*making a phytate variable sum---
I DON'T REALLY KNOW TO ADD IN THE PEOPLE WHO PUT FIBER (5) FOR OTHER
MEDICATIONS (44_8_TEXT)
HERE BUT IT IS A FACTOR;
phytate_sum=Q39_1+Q39_2+Q41_5+Q41_6+Q41_8+Q42_6+Q42_7+Q43_1+Q43_3+Q43_4
+Q43_5+Q43_6+Q43_7;
*making a phytate variable cutoff;
if phytate_sum<=26 then phytate_cutoff=1;
if phytate_sum>=78 then phytate_cutoff=2;

*making a variable for all iron absorption inhibitors;
Inhibitors_sum=polyphenol_sum+calcium_sum+soy_sum+egg+phytate_sum;

*making a coffee cutoff;
if Q42_9<=2 then coffee_cutoff=1;
if Q42_9>=7 then coffee_cutoff=2;

*making a tea cutoff;
if Q42_8<=2 then tea_cutoff=1;
if Q42_8>=7 then tea_cutoff=2;

*making a red wine cutoff;
if Q42_11<=2 then redwine_cutoff=1;
if Q42_11>=7 then redwine_cutoff=2;

*BLOOD LOSS -
*making a blood donation variable Q23;
if Q23_TEXT=999 then Q23_TEXT=.;
if Q20=1 AND Q22=1 then refused_blood=1;
if Q20=2 then refused_blood=2;
if Q23_TEXT=0 then donation=1;
if Q23_TEXT=1 OR Q23_TEXT=2 then donation=2;
If Q23_TEXT>2 then donation=3;
```

```
*making variable about menstruation--how often it occurs in 6 month
Q47s;
if Q47=5 then Q47=.;
if Q47_TEXT=0 then Q47=.;
if Q47_TEXT=2 then Q47=1;
if Q47_TEXT=1 then Q47=0;
if Q47_TEXT=3 then Q47=0.5;
if Q48=4 then Q48=.;

output all_data;

*EVERYTHING BELOW THIS POINT IS FOR THE NO_ANTIDEP DATASET, WHICH WE
DECIDED WAS SO
SIMILAR TO THE ALL_DATA DATASET THAT WE DID NOT USE THESE RESULTS.
HOWEVER, I PREFER
TO KEEP IT INTACT.
I HAD TO DEFINE VARIABLES IN THIS DATA_SET AS WELL IN ORDER TO USE
THEM.
THERE ARE MANY COMMANDS LEFT AS COMMENTS, AS I STRUGGLED TO HAVE
THE NO_ANTIDEP DATASET CONTAIN ALL OF THE APPROPRIATE SUBJECTS.  I
REALIZED IT WAS
NOT INCLUDING SUBJECT 282.  THE COMMANDS BELOW FIXED THE PROBLEM. ALL
USED AND UNUSED
COMMANDSARE RETAINED FOR ACCURATE RECORDS.

*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_1=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_2=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_3=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_4=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
```

```
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_5=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_6=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_7=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_8=.;
*if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR
Q100=142 OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then Q4_9=.;

if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143
OR Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222
OR Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then PHQ9=.;

*PHQ9= Q4_1+Q4_2+Q4_3+Q4_4+Q4_5+Q4_6+Q4_7+Q4_8+Q4_9;
*Fe_Def_Score= Q5_1+Q5_2+Q5_3+Q5_4+Q5_5+Q5_6+Q5_7+Q5_8+Q5_9+Q5_10;

*categorization of severity of depression;
if PHQ9=. then dep_severity=.;
*if PHQ9=9 OR PHQ9=10 OR PHQ9=11 OR PHQ9=12 OR PHQ9=13 then
dep_severity=1;
*if PHQ9=14 OR PHQ9=15 OR PHQ9=16 OR PHQ9=17 OR PHQ9=18 then
dep_severity=2;
*if PHQ9=19 OR PHQ9=20 OR PHQ9=21 OR PHQ9=22 OR PHQ9=23 then
dep_severity=3;
*if PHQ9=24 OR PHQ9=25 OR PHQ9=26 OR PHQ9=27 OR PHQ9=28 then
dep_severity=4;
*if PHQ9=29 OR PHQ9=30 OR PHQ9=31 OR PHQ9=32 OR PHQ9=33 OR PHQ9=34 OR
PHQ9=35 OR
PHQ9=36 then dep_severity=5;
if PHQ9=. then dep_cutoff=.;
```

```
*categorization of severity of depression in two categories;
*if PHQ9=. then dep_cutoff=.;
*if PHQ9=9 OR PHQ9=10 OR PHQ9=11 OR PHQ9=12 OR PHQ9=13 OR PHQ9=14 OR
PHQ9=15 OR
PHQ9=16 OR PHQ9=17 OR PHQ9=18 then dep_cutoff=1;
*else dep_cutoff=2;
if Q100=282 then dep_severity=1;
if Q100=282 then dep_cutoff=1;
*Dichotomizing iron deficiency symptom score. Max possible is 50 (10
questions x 5 points).
Set cutoff to 25 or more;
*If Fe_Def_symptom_Score => 25 then Fe_Def_symptom_sum=2;
*else Fe_Def_symptom_sum=1;

*making the other affective characteristics from Q7 involved in the
no_antidep;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then sad=.;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then cry=.;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then anger=.;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then moody=.;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then OCD=.;
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then unresponsive=.;
```

```
if Q100=102 OR Q100=104 OR Q100=113 OR Q100=117 OR Q100=118 OR Q100=142
OR Q100=143 OR
Q100=147 OR Q100=154 OR Q100=153 OR Q100=156 OR Q100=162
OR Q100=180 OR Q100=188 OR Q100=198 OR Q100=211 OR Q100=212 OR Q100=218
OR Q100=222 OR
Q100=225 OR Q100=228
OR Q100=239 OR Q100=246 OR Q100=258 OR Q100=287 then BMI=.;

If q5_1=1 or q5_1=2 then fatigue=1;
else fatigue=2;

if fatigue=2 and ID=2 then NIDYF=1;
if fatigue=2 and ID=1 then NIDYF=2;

if fatigue=2 and iron_status=2 then NAYF=1;
if fatigue=2 and iron_status=1 then NAYF=2;

if fatigue=1 and iron_status=1 then ANF=1;
if fatigue=1 and iron_status=2 then ANF=2;

output  no_antidep;

Datalines;
1     4     100   4     1     1     2     2     1     1     1     1
      1     2     1     1     1     1     4     1     1
1     1     1     1     3     1     1     1     1     1     1     1
      1     1     1     0     9     1     0     0     1
1     1     1     1     1     1     1     1     1     1     1     1
      1     1     1     5     1     1     4     1     0
.     1     1     2     2     2     2     2     2     2     2     2
      2     2     2     1     1     2     1     2     2
0     2     2     2     1     1     1     1     1     1     0     1
      1     1     1     2     2     2     2     1     1
5     4     1     2     1800  10000 7     45    2     1     1     1
      4     1     0     2     1     1     1
1     3     8     1     3     1     1     1     1     1     6     2
      1     8     3     5     5     4     4     8     1
6     6     1     1     1     1     1     1     1     1     1     1
      1     8     2     1     1     3     1     1     1
8     1     1     1     1     8     1     1     0     2     2     2
      2     2     0     2     14    40.5  12.65
11.98 22    109   50    175   71.9  22.6  23.5  363.00
1     4     101   3     2     2     4     3     2     2     2     1
      1     3     1     1     1     2     2     2     1
1     2     2     2     2     1     2     1     2     2     2     2
      4     1     1     2     2     1     1     2     2
1     1     3     1     1     1     1     1     1     1     1     1
      1     1     1     5     2     1     4     2     0
.     2     3     2     2     2     2     2     2     1     2     2
      2     2     2     2     1     2     2     2     2
0     2     4     3     5     3     3     1     2     1     0     1
      1     1     3     3     3     3     2     1     1
3     1     1     2     2000  7000  7     40    1     7     1     2
      1     1     0     3     1     1     1
1     2     7     1     1     1     2     1     3     1     5     4
      5     5     4     5     3     5     1     8     5
```

```
1       5       1       1       1       4       1       1       1       2       1       1
        1       4       3       1       2       8       2       2       1
3       5       1       1       1       1       1       1       0       2       2       1
        1       2       0       2       0       42      13.18   14.84
23      130     87      161     68.8    31.7    26.5    445.00
1       6       102     4       2       2       3       2       2       3       2       1
        1       2       1       1       1       1       1       1       1
1       3       1       1       1       1       1       1       3       1       2       4
        3       1       1       0       0       2       1       0       2
1       2       2       1       1       1       1       1       5       1       1       1
        1       1       1       1       0       2       .       .       3
4       2       2       2       2       2       2       2       2       2       1       2
        1       1       1       1       1       2       2       2       1
1       1       1       1       1       1       2       1       1       5       1       1
        1       1       2       2       2       2       2       1       5
5       1       1       1       1800    5000    7       35      1       1       1       1
        1       1       0       1       1       1       1
1       8       8       1       1       1       1       1       1       1       6       1
        1       7       5       1       1       1       1       8       1
1       8       1       1       1       1       8       1       1       1       2       1
        1       8       8       2       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       2       0       3       27      46      14.46   48.57
27      110     65      162     53.2    18.4    20.3    322.00
1       4       103     3       1       1       2       2       1       1       2       1
        1       2       1       1       1       2       1       1       1
1       1       1       1       1       1       1       1       2       1       1       3
        1       1       1       0       0       0       1       2       2
1       1       1       1       2       1       2       1       1       1       1       1
        1       1       1       5       2       1       1       1       0       .
2       2       2       2       2       2       2       2       1       2       2       2
        2       2       2       1       2       2       2       1       1
1       1       1       3       2       2       1       1       1       0       1       1
        5       2       2       2       2       2       2       1       2
1       1       1       1850    7000    8       10      3       5       1       3       2
        1       0       1       1       1       1       1
3       6       1       1       1       1       1       4       5       7       3       3
        4       6       3       3       3       3       4       3       2
3       1       1       3       8       1       1       1       2       1       1       1
        8       7       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       2       2       3       3
        4       3       1       29      42      13.03   36.35
25      128     77      162     55.3    21.2    21.1    447.00
1       4       104     2       3       3       5       5       3       3       1       3
        1       5       4       2       2       1       2       5       1
4       5       2       2       3       2       2       2       4       5       5       5
        5       1       2       2       0       0       1       0       2
1       1       1       1       3       1       1       5       5       1       1       1
        1       1       1       1       0       0       1       4       1       3
2       3       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       2       1       1       4       1       5       0       0       1
        1       1       2       2       2       2       3       1       2
0       1       1       1       .       4000    7       30      2       2       1       1
        1       9       0       1       1       1       1       9
1       5       1       1       1       1       9       1       1       5       2       3
        6       1       1       3       1       4       8       1       1
```

```
8       1       1       1       1       1       1       1       2       3       1       9
        2       2       1       1       1       1       1       10      1
8       1       1       1       1       1       9       0       1       2       2       2
        2       0       2       17      41      12.99   10.56   21
114     83      160     136.4   25.1    24.2    386.00
1       3       105     4       2       2       1       4       4       3       4       1
        1       4       1       1       2       4       2       4       2
2       1       3       2       4       2       2       1       2       1       2       3
        2       1       0       0       0       0       0       0       2
1       1       1       2       2       1       1       5       1       1       1       1
        1       1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       1       1       1       2
0       1       3       2       2       1       1       1       1       1       0       1
        1       1       2       1       1       1       1       1       1
2       1       1       1       1600    5000    8       20      2       3       1       1
        3       1       0       1       1       1       1
1       1       2       1       1       1       5       1       3       1       5       6
        1       4       1       1       4       5       1       8       1
1       3       1       1       1       1       8       3       1       2       4       1
        1       4       1       1       1       1       2       2       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       2       0       2       29      44.3    14.4
20.87   30      128     83      158.8   180.6   38      32      337.78
1       3       106     3       2       2       2       3       2       2       1       1
        1       2       1       1       2       2       1       1       1
2       2       2       2       2       1       2       2       4       3       3       4
        2       2       2       1       0       0       1       1       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       1       0       3       .       .       0
.       2       3       2       2       3       3       2       2       1       2       2
        2       2       2       2       2       2       1       1       2       2
0       1       1       1       3       3       3       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       1       1       1       .       .       7       .       2       8       8       1
        3       1       0       1       1       1       1       1       6
1       1       3       6       1       1       1       1       2       1       2       6
        1       6       1       3       1       8       2       1       1
1       1       6       1       1       1       1       2       1       1       1       1
        1       1       5       2       1       1       1       1       1
1       1       1       6       6       1       0       1       3       2       2       2
        0       2       26      38.3    11.95   5.48
31      123     71      159.5   74.4    35.8    29.1    343.54
1       4       107     3       2       1       1       2       1       1       2       1
        1       2       1       1       1       2       1       1       1
1       1       2       2       1       1       1       1       2       2       2       2
        1       1       0       2       2       3       0       0       1
1       2       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       1       0       2       .       .       999
0       2       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       1       2       1       2       2
0       1       2       1       1       1       2       1       1       1       0       2
        2       1       1       1       2       2       1       1       1
5       2       2       3       1700    .       6       .       3       5       1       3
        3       1       0       3       1       1       1       1
1       6       1       1       2       5       1       6       5       1       3       8
        8       3       6       8       8       1       8       8       1
```

```
1       1       8       1       1       8       1       1       1       1       1       1
        8       1       1       1       1       1       1       1       1
8       1       8       1       1       8       8       1       2       3       2       2
        2       0       1       2       47      14.47   13.89
42      142     91      165     70.1    28.8    25.7    347.70
1       4       108     3       2       1       3       4       2       2       4       2
        1       3       3       1       2       4       2       2       1
1       3       2       2       3       1       2       2       2       2       1       3
        2       2       1       .       1       1       0       1       1
1       3       1       2       3       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       2
3       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       3       1       2       4       4       1       2       1       0       1
        1       1       2       2       3       2       1       1       5
4       2       1       1       1800    .       7       40      3       6       3       6
        7       1       0       2       1       4       2       1
2       2       4       1       1       1       1       4       1       3       2       5
        6       4       3       7       6       4       8       4       1
3       1       1       1       4       8       5       1       1       3       5       1
        3       1       1       1       8       1       1       9       3
1       1       1       2       1       2       1       0       2       2       2       2
        2       0       2       5       40.7    12.4    18.25
26      125     76      171     66.2    25      22.6    269.75
1       4       109     4       2       2       2       2       2       1       1       1
        1       2       1       1       2       2       1       2       2
2       3       3       1       3       1       3       2       1       1       1       2
        1       1       1       1       0       2       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       2       2       2       2       2       1       1       1       0       1
        1       1       1       2       2       1       2       5       2
2       2       1       1       3000    .       7       0       3       4       1       2
        2       1       0       1       1       1       1       1
1       1       1       1       1       1       1       5       1       5       1       1
        1       1       4       1       4       1       8       1       1
1       1       1       1       4       8       1       4       4       1       1       1
        3       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       3       1
        2       0       1       .       44.5    14.02   64.84
26      102     62      160.7   58      26.4    22.4    279.97
1       4       110     3       2       2       2       4       2       2       1       1
        2       4       1       1       1       3       1       4       1
4       1       1       1       2       1       1       3       2       2       4       4
        1       2       0       1       1       0       1       2       2
1       4       1       1       3       1       2       1       1       1       1       1
        1       1       4       1       0       2       .       .       3
3       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       2       2       1       3       3       2       1       2       1       0       1
        1       1       2       2       1       1       3       2       1
2       2       3       1       1600    8000    9       30      2       3       1       1
        5       1       0       1       1       1       1
1       3       4       1       1       1       1       1       2       1       5       3
        2       6       1       1       4       3       2       8       4
```

```
1       8       1       1       1       6       5       1       1       3       2       7
        1       4       4       1       1       1       4       4       1
1       1       2       1       1       1       1       1       0       1       2       2
        2       2       0       2       22      45      13.65   4.92
26      138     77      160     82.7    37.7    31.9    395.37
1       5       111     2       1       1       3       2       3       1       1       1
        1       2       1       1       1       2       1       2       1
1       1       1       1       1       1       1       1       1       2       1       2
        1       1       0       0       0       0       1       0       1
1       1       1       1       3       1       3       1       1       1       1       1
        1       1       1       1       0       1       4       2       2
1       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       5       1       1       3       2       1       4       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       2000    10000   9       0       3       2       1       1
        1       1       0       2       1       3       1
1       2       1       1       1       1       3       1       6       1       7       2
        1       3       1       1       1       3       5       3       1
1       8       1       1       1       1       6       3       1       3       4       1
        1       4       2       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       21      41      12.73   5.30
22      124     73      181     60      27      18.3    418.87
1       4       112     4       1       1       1       2       1       1       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       1       2
        1       1       1       0       0       0       0       0       1
1       1       1       1       1       1       1       5       1       1       1       1
        1       1       1       1       0       1       4       1       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       1       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       2       2
3       2       1       5       2000    11000   8       30      1       7       1       1
        4       1       0       2       1       1       1
1       1       4       1       1       1       2       1       1       1       7       4
        1       6       3       1       1       3       3       8       6
1       4       1       1       1       6       8       1       3       4       1       1
        1       8       3       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       2       0       2       23      40      11.63   6.97
22      119     69      168     66.8    27.6    23.7    381.43
1       2       113     3       1       1       2       2       1       1       1       3
        1       2       1       1       1       1       1       2       2
1       1       2       2       1       1       2       1       1       1       1       3
        1       2       3       2       0       1       1       2       1
1       1       2       2       1       1       3       1       5       1       1       1
        1       1       1       1       1       0       2       .       .       0
.       1       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       1       1       1       2       3       1       1       1       0       2
        1       1       1       2       2       2       2       2       3
2       2       3       5       1200    10000   8       1       2       2       2       2
        2       1       0       1       1       1       1
1       2       2       1       2       1       2       1       3       1       4       2
        4       4       4       6       4       6       3       8       4
```

2 1 1 1 1 1 1 1 3 4 1 6
1 5 5 1 1 1 1 1 1
8 8 8 8 8 8 8 1 0 1 2 1
2 2 0 2 24 39 11.87 13.86
30 120 69 161 86.4 40.6 33.3 301.50
1 4 114 4 2 1 1 3 1 1 1 2
1 2 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 2 1 1 3
3 1 1 1 0 1 1 1 2
1 2 2 1 1 1 1 2 1 1 1 1
1 1 1 5 3 2 . . 1
0 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 1 1 1 2 2
0 1 1 1 1 1 1 1 1 1 0 1
1 1 1 2 2 2 2 2 5
5 1 1 1 . 10000 8 30 1 2 1 1
2 9 0 1 1 1 1 1
5 3 3 3 1 4 1 6 1 3 8 3
1 3 4 2 8 1 8 1 1
1 2 1 1 1 1 1 1 1 1 1 1
4 1 1 1 1 5 1 1 1
1 1 1 1 1 1 1 0 1 2 2 1
2 0 2 24 41 12.78 14.87
36 149 95 157.5 56.7 26.8 22.7 393.11
1 4 115 3 3 2 5 5 5 1 2 3
1 5 3 2 1 4 3 2 1
2 2 4 2 2 4 1 1 2 1 4 3
3 3 0 3 2 1 1 2 1
1 1 1 1 1 1 2 1 1 1 1 1
5 1 1 1 0 1 4 1 2
2 3 3 2 2 2 3 2 1 1 2 2
2 2 2 2 1 2 2 2 2
0 2 4 4 5 3 4 1 1 1 0 1
1 1 3 3 3 3 3 1 1
1 2 2 1 2100 10000 8 15 5 4 1 1
6 1 0 1 1 1 1
1 2 4 1 1 1 1 1 5 5 6 3
1 4 1 1 4 5 3 8 3
1 4 1 1 1 2 7 1 5 1 1 1
1 3 4 1 1 1 1 1 1
1 1 1 1 1 1 1 1 0 2 2 2
3 2 0 2 . 37.5 11.65
17.12 28 119 73 173 73.3 30.9 24.5 360.26
1 3 116 4 1 2 1 1 2 1 3 1
1 1 1 1 1 1 1 1 2 1
1 2 1 1 1 1 1 1 2 1 2 2
2 3 3 2 2 0 2 1 1
1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 3
2 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 3 2 1 2 2
0 1 3 2 2 3 3 1 1 1 0 1
1 1 2 2 2 2 2 1 1
2 1 1 1 . . 8 30 2 2 1 1
3 1 0 1 1 1 1 1 3
4 1 1 1 3 1 1 1 7 2 2 5
2 1 3 1 5 8 5 2 8

```
1       1       1       1       1       1       1       1       1       8       1       8
        5       3       1       1       5       5       1       1       1
1       1       1       1       1       1       0       2       2       2       2       2
        0       2       .       38.5    12.12   21.32
18      116     72      172     65      26      22      326.61
1       4       118     2       4       5       5       3       3       3       2       1
        2       2       1       1       1       1       1       1       1
1       2       2       2       2       3       3       1       3       4       4       4
        4       2       1       2       9       1       0       1       1
1       1       1       2       3       1       2       5       5       1       1       1
        1       1       1       1       1       0       3       .       .       0
.       3       3       2       3       3       3       3       3       1       2       2
        2       2       2       2       3       3       3       2       3
0       1       1       1       1       1       2       1       1       1       0       1
        1       1       3       3       3       3       4       1       3
2       2       1       1       1000    .       5       .       2       2       2       1
        2       1       0       1       1       1       1       1
8       2       2       1       1       1       1       2       1       4       3       4
        3       2       2       3       2       2       3       1       1
3       1       1       1       5       1       1       1       1       1       1       1
        8       9       1       9       9       9       9       1       1
1       1       1       1       1       1       1       0       3       2       3       1
        2       0       2       .       36      14.43   12.70
21      148     102     149     49      15.7    22.1    342.52
1       5       119     4       1       1       1       1       1       1       1       1
        1       1       1       1       1       2       1       1       1
1       1       2       1       1       1       1       2       1       1       1       2
        1       1       1       2       0       1       0       0       1
1       2       2       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       5       4       2       2       3       1       1       1       0       1
        1       1       1       2       2       2       2       2       2
5       1       1       5       3000    10000   8       45      2       3       1       1
        1       1       0       1       1       1       1
1       4       3       1       1       1       3       1       8       7       5       5
        4       6       8       7       4       8       3       8       1
1       4       1       1       1       1       8       1       4       4       1       1
        1       3       2       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       2       0       3       8       43.5    13.46
6.54    24      132     72      173     71.3    23.7    23.9    363.47
1       3       120     4       1       1       1       3       1       2       2       1
        1       3       1       1       1       2       2       1       1
2       1       1       1       2       1       1       1       2       2       2       2
        1       1       1       0       0       2       2       0       2
2       1       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       1       1       2       2       2       2
0       1       5       5       4       2       2       1       1       1       0       3
        1       1       3       3       3       3       2       1       1
1       2       2       4       2000    .       7       30      1       2       1       1
        1       1       0       2       1       1       1       1
3       6       2       2       1       2       1       4       1       7       1       2
        6       1       1       3       8       5       8       2       1
```

```
1       1       4       2       1       8       1       4       4       1       4       1
        8       7       1       5       6       9       9       1       1
1       1       1       4       1       1       1       0       1       2       3       1
        4       1       3       .       43      13.59   12.70
24      128     72      172     63.8    21.7    21.6    395.37
1       3       121     4       1       1       2       2       1       2       1       1
        1       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       0       0       0       1       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
2       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       2       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       1       1       4       2500    4000    7       40      3       4       1       2
        4       1       0       2       1       1       1
1       4       5       1       1       1       1       1       8       5       6       4
        2       5       1       1       1       4       3       8       1
1       3       1       1       1       3       8       1       3       2       1       1
        1       4       1       1       4       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       1       0       3       .       39      13.31   15.30
25      137     89      172     74.7    33.9    25.3    362.52
1       5       122     3       1       1       1       2       2       1       1       1
        1       2       1       3       2       3       2       2       1
1       1       2       1       2       1       1       1       2       1       1       1
        1       1       1       1       1       1       1       1       2
1       1       2       1       2       1       1       1       1       1       1       1
        1       1       1       5       2       1       2       1       4
2       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
3       2       3       1       1       3       1       1       1       1       0       3
        3       1       1       1       2       2       2       1       1
1       1       1       1       .       .       7       10      6       5       2       3
        1       9       0       4       2       2       1       9       1
4       1       1       2       1       9       1       1       5       1       1       6
        3       2       1       1       4       8       2       2       1
1       4       1       3       5       2       3       4       1       2       9       2
        1       1       1       1       2       2       10      1       6
1       1       1       1       1       9       0       1       2       3       1       2
        0       2       17      43      14.11   8.17    23
137     82      162     73.6    32.1    28      405.95
1       4       123     3       1       1       2       1       1       1       1       1
        1       3       1       1       2       2       1       2       1
1       1       1       1       1       1       1       1       2       1       1       2
        1       1       0       1       0       2       0       1       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       2       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       5       1
1       1       1       1       1500    10000   8       30      2       7       1       1
        3       1       0       1       1       1       1
1       2       3       1       1       1       1       1       1       1       8       4
        4       1       4       6       1       8       3       8       1
```

```
4       4       1       1       1       1       8       1       4       2       2       1
        1       3       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        3       2       0       2       6       41.5    13.12

7.83    27      114     70      177.5   70.9    31.7    22.4    498.65
1       5       124     3       1       1       3       1       1       2       1       1
        1       2       1       1       1       1       1       1       1
1       2       2       3       1       1       1       2       1       3       1       2
        1       1       0       1       1       2       1       2       1
1       1       3       1       1       1       1       1       1       1       1       1
        1       1       2       1       0       2       .       .       3
4       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       2       5       4       5       3       2       1       1       1       0       1
        1       1       2       1       1       1       2       5       1
1       1       1       1       .       .       7       10      3       2       1       1
        5       1       0       2       1       1       1       1       1
4       1       1       1       4       1       3       1       3       2       1       1
        1       1       1       1       6       3       1       1       1
1       1       1       1       1       1       1       2       7       6       1       2
        3       1       1       1       2       1       1       3       1
1       1       1       1       4       1       0       2       2       2       2       2
        0       2       4       43      13.52   7.58    36
125     87      173     64.1    27.2    21.4    307.56
1       5       125     3       2       2       2       2       3       2       1       1
        1       2       2       1       1       1       1       2       1
1       1       1       1       1       1       1       1       2       2       2       2
        2       2       0       0       0       0       0       1       1
1       1       1       1       1       1       5       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       1
4       2       5       5       3       2       2       1       1       1       0       1
        1       1       1       2       2       2       2       1       1
1       1       1       1       3200    .       6       120     2       2       1       1
        2       1       0       1       1       1       1       1
1       1       1       1       1       1       1       2       1       2       1       2
        2       2       1       2       4       4       8       1       1
1       1       1       1       1       8       1       1       1       1       1       1
        4       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       2       14      39      12.33   34.75
20      126     83      159.5   55.1    20      21.5    373.47
1       5       126     3       2       2       1       2       2       1       1       1
        1       2       2       1       1       1       1       2       1
1       1       1       1       2       2       1       1       2       1       1       2
        2       1       2       0       0       1       1       0       2
1       2       2       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
5       2       3       2       3       5       4       1       2       5       3       1
        5       5       2       2       2       2       2       1       1
1       4       1       1       2500    .       7       100     2       8       1       1
        8       9       0       3       1       5       1       9
2       8       1       2       1       1       9       1       1       4       1       5
        8       8       1       5       8       6       8       1       1
```

```
8       1       1       1       1       1       1       1       3       1       1       9
        8       8       8       4       9       5       5       10      1
8       1       1       1       1       1       1       0       2       2       2       2
        5       0       4       .       43      13.15   25.83
20      113     69      158     39.4    5       15.8    367.78
1       4       127     3       2       1       2       3       2       1       3       1
        1       2       2       1       1       5       1       2       1
2       1       2       1       2       1       1       1       2       1       2       1
        1       1       2       1       0       0       1       0       1
2       2       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       1       0       2       .       .       1
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       2       2       4       1       1       5       4       1
        1       1       2       2       2       2       2       1       1
3       2       1       3       .       .       8       45      3       5       2       1
        1       9       0       2       1       2       1       9       3
6       1       1       1       2       9       4       1       3       3       3       4
        2       1       3       3       5       8       6       5       1
1       2       1       3       4       1       1       1       2       1       1       6
        4       4       2       3       1       1       1       1       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       2       7       44.5    13.72   17.75
20      118     71      173     60.1    23.8    20      379.46
1       5       128     3       1       1       1       1       1       1       3       1
        1       3       1       1       3       1       3       3       1
1       1       1       1       1       1       1       1       2       3       2       3
        1       1       1       2       1       2       1       1       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       1       2
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       5       4       2       2       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       2000    .       7       0       3       3       1       2
        5       1       0       1       1       1       1       1
5       7       1       1       1       8       1       6       1       6       8       8
        8       3       1       3       5       5       8       4       1
8       1       1       1       1       1       1       1       1       1       1       1
        4       3       1       1       1       3       3       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        4       1       4       259     44.5    13.64   7.50
24      102     67      165     54.3    19.8    19.9    338.87
1       5       129     3       1       1       1       2       3       1       2       2
        1       1       2       1       1       2       1       1       1
1       1       1       2       2       1       1       1       2       2       2       2
        1       1       1       0       1       2       1       0       2
1       1       1       1       5       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       3       3       3       3       3       3       3       3       1       2       1
        1       1       1       1       1       2       2       2       2
0       2       1       1       2       2       2       1       1       1       0       1
        1       1       3       3       3       3       3       2       3
2       1       1       1       1800    7000    6       30      2       2       1       2
        2       1       0       2       1       1       1
1       1       1       1       1       1       1       1       2       1       1       2
        3       5       1       1       1       1       1       8       2
```

```
1       8       1       1       1       4       2       1       1       1       1       1
        1       7       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       3       3       2
        2       2       0       2       .       38.5    11.9
21.08   24      108     69      164     56.5    21      21      317.85
1       4       130     3       2       2       2       3       4       2       3       2
        1       2       2       1       1       1       1       2       1
2       3       1       1       2       1       1       1       2       1       1       2
        1       2       0       0       0       0       0       0       1
1       1       1       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       1       2       2       2
0       2       2       1       1       2       2       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       .       .       8       30      2       2       2       2
        2       1       0       1       1       1       1       1       1
1       1       1       1       1       1       2       1       1       2       2       1
        1       1       1       1       1       1       8       6       1       8
1       1       1       5       4       1       1       1       1       1       1       8
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       2       .       41.5    12.8    14.92
23      115     66      168     59.5    25.1    21.1    386.75
1       3       131     3       2       1       3       2       2       1       1       1
        1       1       2       1       1       2       1       2       1
2       2       1       1       1       1       1       1       1       1       1       1
        1       2       0       9       1       0       1       0       1
1       1       1       1       6       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       3       3       2       2
0       1       2       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       2       0
0       2       2       2       .       .       .       .       1       3       1       2
        1       1       0       1       1       2       1       1       3
4       1       1       1       1       1       1       1       4       2       1       3
        3       1       1       3       5       8       1       1       3
1       1       1       1       1       1       1       1       2       1       1       4
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       3       2       2       2       2
        0       1       .       42.5    13.65   16.92
19      114     70      162.5   53.9    20.4    20.3    330.55
1       4       132     3       4       4       5       5       5       5       4       1
        3       3       3       4       4       2       1       3       2
4       5       4       1       2       1       1       4       3       3       4       4
        3       3       2       1       0       0       0       1       4
1       1       2       2       1       1       2       1       1       1       1       1
        1       1       1       1       1       0       1       4       3       4
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       1       1       1       1       1       1       1       1       0       1
        1       1       2       1       3       3       3       5       1
1       1       1       1       .       .       4       .       3       4       1       1
        1       1       0       2       1       1       1       1       2
1       1       1       1       1       1       1       1       3       3       1       1
        2       1       1       2       4       7       1       1       2
```

```
1       1       1       1       1       1       2       1       6       5       1       1
        4       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       2       2       2       2       4
        3       2       .       46      14      9.00    23      138
86      165     107     46.2    39.3    379.16
1       5       133     4       1       1       1       2       1       1       1       1
        1       1       1       1       1       1       1       1       1
1       2       2       1       2       1       1       1       1       1       1       3
        2       2       1       1       0       0       1       1       1
1       2       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       2       2       3       1       1       1       0       4
        1       1       2       2       2       2       2       1       5
5       2       1       5       1300    12000   6       60      2       2       1       2
        4       1       0       2       2       2       1
1       3       5       1       1       3       4       1       3       1       2       4
        4       3       4       3       3       3       3       8       1
1       3       1       3       1       1       8       1       2       1       1       5
        1       4       3       2       3       1       4       4       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       16      43      13.75   7.73
39      128     87      163     63.9    24.7    24.1    404.56
1       5       134     3       2       1       1       3       4       1       2       1
        1       2       1       1       1       1       1       3       1
1       1       1       1       1       1       1       1       1       2       2       2
        1       1       1       0       0       0       1       0       1
1       3       2       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
0       2       2       2       2       2       2       2       2       2       2       2
        2       2       2       2       1       1       1       2       2
0       1       4       4       1       1       2       1       1       1       0       1
        1       1       2       1       1       1       2       1       4
3       2       2       1       1700    10000   7       30      1       4       1       1
        3       9       0       4       1       2       1
1       2       8       1       1       2       3       1       4       8       1       2
        2       6       3       3       3       5       3       8       1
1       8       1       4       1       1       1       1       1       1       1       1
        1       8       8       1       1       1       6       1       1
1       1       1       1       1       1       1       1       0       1       2       3
        2       2       0       2       20      46      14.53   16.71
20      113     79      163     72.3    33      27.2    397.63
1       5       135     3       1       1       2       3       2       1       3       1
        1       3       1       1       2       2       1       1       1
1       2       2       1       3       1       1       1       1       1       1       2
        1       1       0       1       2       0       0       2       2
1       1       2       1       1       1       2       1       1       1       5       5
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       1       1       2       2       1       2       2
        2       2       2       2       2       2       2       2       1
6       1       1       1       1       1       2       1       1       1       0       5
        1       3       2       2       2       2       2       5       2
4       1       1       1       1400    .       6       0       5       5       1       1
        3       1       0       4       2       2       1       1
1       4       1       1       1       1       1       2       1       4       4       2
        5       2       1       4       4       4       8       1       1
```

```
4       1       1       1       1       1       1       1       1       1       6       1
        3       6       1       1       2       2       1       1       1
1       1       1       1       1       1       1       0       2       2       3       1
        2       0       3       23      47      15.39   17.90
37      131     79      155     64.2    32.2    26.7    572.45
1       4       136     2       2       1       2       3       2       1       1       1
        1       3       1       1       1       1       1       2       2
2       1       1       1       1       1       1       1       1       2       1       2
        1       1       0       2       2       1       1       3       1
1       1       2       1       1       1       1       1       1       5       1       1
        5       1       5       1       0       3       .       .       0
.       1       1       2       2       2       2       2       1       1       2       2
        2       2       2       2       2       2       2       2       2
0       2       2       2       2       2       1       1       1       1       0       1
        1       1       2       2       2       2       1       2       1
1       1       1       1       2000    8000    8       10      3       1       1       1
        2       2       0       2       1       1       1
1       1       1       1       1       1       1       1       3       1       1       1
        1       3       1       1       1       1       3       7       1
1       3       1       1       1       1       1       1       2       1       1       7
        1       4       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       4       1       4       .       45      13.71   19.51
49      154     97      166     85.5    41.3    31      437.78
1       5       137     3       2       3       5       3       5       4       4       4
        1       4       5       3       2       3       4       5       2
3       5       2       2       3       2       3       4       3       1       4       4
        2       2       0       1       1       2       1       .       2
1       1       4       2       1       1       1       2       1       1       1       1
        1       1       1       1       0       4       .       .       0
.       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       2       2       2       1       2
0       3       5       5       5       3       5       4       5       0       0       2
        2       1       2       1       3       3       2       2       1
2       1       1       2       3000    .       9       60      3       5       1       1
        5       1       0       2       1       1       1       1
3       4       1       1       1       2       1       4       1       6       3       4
        4       1       1       1       1       4       8       4       1
2       3       3       1       2       2       1       1       2       1       1       1
        3       1       3       1       4       1       1       1       1
8       1       1       1       1       1       1       0       2       2       2       2
        2       0       2       .       44.5    13.23   14.42
20      139     69      173.5   78.3    32.7    25.9    514.86
1       4       138     2       2       2       3       2       4       5       5       5
        5       2       2       1       1       2       1       2       1
1       4       1       1       2       3       1       1       4       1       2       3
        4       3       1       0       0       2       1       0       2
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       1       1
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       2       2       5       1       5       1       1       4       5       1
        1       1       2       1       1       1       2       2       2
3       2       2       1       1200    15000   6       60      2       4       1       1
        4       1       0       2       1       1       1
1       3       7       2       1       1       3       1       3       4       1       4
        4       7       5       6       6       6       2       8       1
```

1 6 1 7 1 4 1 1 1 1 3 1
1 3 1 2 9 2 1 1 1
1 1 1 1 1 1 1 1 0 1 2 2
2 1 0 2 33 41.5 12.31
22.98 19 113 60 171.4 68.8 26.3 23.5 462.67
1 5 139 2 2 1 3 3 3 2 1 1
1 3 3 1 1 1 3 3 1
1 3 1 1 1 1 1 1 1 2 3 3
1 3 4 1 1 2 1 . 2
1 1 1 2 2 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 1
2 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 3 2 2 2 2
0 1 3 1 2 1 2 1 1 1 0 2
1 1 1 1 1 1 1 3 3
2 3 2 3 1400 . 5 90 1 4 1 1
3 1 0 6 1 1 1 1
2 5 1 1 1 3 1 3 1 8 4 3
5 4 1 1 4 3 8 4 1
3 1 1 1 3 5 2 1 2 3 3 1
7 7 1 1 9 1 1 1 5
5 3 4 1 1 5 1 0 1 2 2 2
2 0 2 0 39 11.6 7.22
19 116 61 163 75.4 31.9 28.4 506.68
1 5 140 3 3 1 1 1 1 2 1 1
1 2 2 1 1 2 1 2 1
2 2 2 1 1 1 1 1 1 2 1 2
1 1 0 1 2 0 0 . 1
1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 0 4 . . 0
. 2 2 2 2 2 2 2 2 2 2 2
2 2 2 2 1 2 1 2 2
0 2 3 1 3 3 2 1 3 1 0 2
2 2 2 2 2 1 2 5 3
5 1 1 1 . 0 8 . 1 3 3 1
3 1 0 4 1 1 1 1 5
3 3 3 1 1 1 5 1 1 4 1 2
4 4 5 5 5 4 4 3 4
1 1 1 4 5 5 5 1 1 1 1 5
4 1 1 5 4 3 1 2 2
2 2 1 2 1 1 0 2 2 2 2 2
0 2 . 42.5 13.56 32.90
33 97 65 163 54 27.8 20.3 359.82
1 4 141 3 1 1 1 2 2 2 2 2
1 2 1 1 2 1 1 1 1
2 1 1 1 1 2 2 1 2 1 1 3
1 1 1 1 1 0 0 1 1
1 1 3 1 1 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 2
4 2 2 2 2 3 3 2 2 2 1 2
1 1 2 1 1 1 1 2 2
0 1 2 1 2 1 2 1 1 1 0 1
1 1 2 1 3 3 3 1 1
2 1 1 1 1500 5000 7 24 1 1 1 1
7 1 0 1 1 1 1
1 3 3 1 5 1 1 5 1 1 3 2
1 2 1 3 3 3 2 8 1

```
1       1       3       3       1       3       3       1       3       4       1       1
        1       3       3       2       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       .       41      13.35   19.51
26      120     81      163.2   95.4    41.8    35.5    383.40
1       5       142     3       1       1       3       3       2       1       1       1
        1       3       1       1       1       1       2       2       1
1       1       1       1       2       2       1       1       1       1       1       2
        1       1       1       1       0       0       0       1       1
1       1       1       1       1       1       1       1       5       1       1       1
        5       1       5       1       0       1       4       1       1
4       2       2       2       2       2       2       2       1       1       2       2
        1       1       2       2       1       2       2       1       2
0       2       3       2       3       2       2       1       2       1       0       1
        1       1       1       2       2       2       2       2       2
1       2       1       3       1200    12500   6       35      3       4       1       1
        4       9       0       1       1       2       1
9       1       3       1       1       1       4       9       2       1       4       2
        2       3       1       1       1       3       2       8       4
1       4       1       1       1       1       1       1       1       1       1       7
        9       2       5       1       1       1       3       1       10
1       1       1       1       1       1       1       9       0       2       1       1
        1       1       0       2       27      42      12.26   3.75
31      122     67      162     76.4    35.7    29.1    324.27
1       3       143     3       2       2       4       3       2       1       2       1
        1       2       2       2       1       2       1       3       1
3       5       1       1       1       1       1       1       2       2       5       5
        3       3       2       1       1       0       0       0       2
1       1       3       2       1       1       1       5       5       1       1       1
        1       1       1       2       0       2       .       .       1
4       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       3       1       2       1       2       1       1       1       0       1
        1       1       1       1       1       1       2       2       1
5       2       1       1       1800    .       9       15      1       7       1       1
        4       1       0       2       1       2       1       1
3       3       1       1       1       1       1       5       1       7       3       1
        6       5       1       3       8       4       8       1       1
6       1       1       1       2       7       1       3       2       2       1       1
        6       9       1       1       9       9       9       1       1
1       1       1       1       1       1       1       0       2       2       2       1
        1       0       3       34      43      13.33   35.44
21      119     92      172.3   65.4    29.5    21.9    378.43
2       3       144     3       2       1       2       2       2       1       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       1       2
        2       1       2       1       1       1       0       1       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       2       2       2       1       2       1       1       1       0       1
        1       1       2       2       2       2       2       5       2
3       3       3       2       2000    10000   9       30      1       3       2       2
        3       1       0       1       1       1       1
1       3       5       1       1       1       1       1       3       1       1       2
        3       1       2       1       1       1       3       8       3
```

```
2       1       1       2       1       3       5       2       1       4       1       1
        1       1       1       1       1       1       1       1       1
1       1       2       1       1       1       1       1       0       1       2       2
        2       2       0       2       17      39.67   13.04
25.00   24      92      46      160     62.7    25.1    24.5    362.59
2       5       145     4       2       1       3       2       2       1       1       1
        1       2       2       1       1       1       1       2       1
1       2       1       1       1       1       1       2       2       2       1       2
        1       1       0       0       0       1       0       0       2
1       1       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       2       2       2       2       2       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
4       2       3       3       1500    5000    7       30      4       4       1       1
        7       1       0       1       1       1       1
1       4       6       1       1       1       2       1       4       1       6       5
        1       8       1       2       2       6       1       8       2
1       5       1       1       1       1       8       2       4       2       1       4
        1       4       2       1       1       1       8       1       1
1       1       1       1       1       1       4       1       0       1       2       2
        2       2       0       2       16      41.25   13.76
17.77   30      135     87      154     70.9    31      29.9    306.24
2       3       146     4       2       1       3       2       2       1       1       1
        1       4       1       1       1       1       2       1       2
2       1       1       1       1       1       1       1       2       1       1       1
        2       1       2       1       0       0       1       1       2
1       4       4       1       2       1       1       1       1       1       1       1
        1       1       5       1       0       1       4       1       1
4       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       1       2
0       2       3       1       2       4       2       1       3       1       0       1
        1       1       2       2       2       2       2       1       1
5       1       1       2       1500    8000    7       60      2       3       1       1
        5       1       0       1       1       1       1
1       2       1       1       1       3       1       1       3       1       6       5
        1       5       1       1       3       6       3       8       5
1       5       1       1       1       1       2       1       1       3       1       1
        1       6       1       1       1       1       1       1       5
1       6       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       11      39.75   13.04
20.77   22      116     69      169.25          64.8    23.6    22.7    454.45
2       4       147     3       2       2       5       5       5       2       3       1
        1       4       3       2       4       4       5       4       4
4       3       2       2       2       2       2       3       2       1       3       3
        2       3       2       1       3       2       1       1       2
1       4       1       1       3       1       1       1       5       1       1       1
        1       1       1       1       0       2       .       .       2
3       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       1       1
7       3       3       3       3       3       4       4       5       1       0       1
        1       5       1       2       2       2       2       1       4
4       5       5       5       1600    10000   6       60      2       8       2       2
        8       1       0       2       1       1       1
1       5       4       1       1       1       4       1       8       1       1       8
        3       5       2       4       8       8       2       8       1
```

```
1       1       1       1       1       1       1       1       1       1       1       5
        1       5       1       1       1       1       1       1       1
1       1       1       1       1       1       8       1       0       1       2       3
        2       2       0       1       18      43.25   12.91
7.38    39      144     74      154     69      31.6    29.1    308.03
2       4       148     4       1       1       2       3       2       1       1       2
        1       2       1       1       1       2       1       1       1
1       2       1       1       1       1       1       1       2       2       2       2
        1       1       1       2       0       0       1       1       1
1       1       1       1       3       2       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       3       2       4       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       2       1       1       1800    .       8       30      5       3       1       2
        4       9       0       2       1       1       1       1
1       3       1       1       5       3       1       2       3       2       3       8
        3       2       3       2       3       3       8       2       1
5       1       1       1       1       8       1       2       6       3       1       1
        3       1       1       1       1       1       1       1       1
1       1       1       4       4       1       1       0       2       2       2       1
        4       3       4       .       46.83   15      12.85
23      99      63      174     57.9    22.2    19.1    356.39
2       3       149     3       2       1       3       4       2       1       2       2
        1       2       1       2       2       2       1       2       1
3       2       2       1       2       2       1       2       1       1       2       2
        2       1       1       2       1       1       1       .       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       2
4       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       3       3       3       3       3       1       1       1       0       1
        1       1       2       1       2       2       2       2       1
1       1       1       1       2000    10000   8       30      1       3       1       2
        4       1       0       2       1       1       1
1       1       3       1       1       2       1       1       1       1       3       4
        1       3       1       1       3       2       2       8       1
1       6       1       1       1       2       9       1       1       3       3       1
        1       2       4       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       0       40.5    13.61
4.62    19      102     67      168.5   66.3    29.1    23.4    398.94
2       3       150     3       1       1       1       2       2       2       1       1
        1       2       1       1       1       2       1       1       1
2       1       3       3       2       1       2       1       2       1       2       3
        2       4       1       2       0       1       1       1       1
1       1       1       4       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       4       1
.       3       3       2       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       1
7       2       5       5       5       3       5       1       1       1       0       2
        5       2       2       2       2       2       2       1       1
5       1       1       5       .       .       8       70      3       4       1       1
        5       1       0       1       1       1       1       1       1
2       1       1       8       1       8       3       1       2       8       2       7
        6       3       8       8       2       8       4       1       1
```

```
1       6       1       3       2       1       1       2       1       1       1       4
        1       1       1       1       1       1       1       1       1
1       1       1       1       4       1       0       1       2       2       2       2
        0       2       23      41      13.64   16.38   26
102     53      170     66.6    26.1    23      382.10
2       4       151     3       3       2       2       2       2       2       3       1
        1       2       2       2       1       1       2       2       2
2       1       2       2       3       5       1       1       2       1       1       1
        3       2       1       0       0       1       1       2       2
1       3       2       2       3       5       1       1       1       5       1       1
        1       1       1       2       4       2       .       .       0
.       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       2       1       2       2       4       1       1       1       0       1
        1       1       2       1       3       2       3       2       1
4       2       1       1       1700    .       7       30      3       2       1       2
        2       1       0       1       1       2       1       1
3       2       1       1       2       4       1       2       1       4       3       3
        3       3       2       4       8       2       8       1       1
2       1       1       1       1       1       1       1       2       1       8       1
        2       2       3       1       1       2       2       1       1
5       1       8       1       1       1       8       1       2       3       2       3
        2       0       2       .       45.75   15.48   33.38
35      125     74      161.25          83.3    38.7    32.1    323.53
2       5       152     4       1       1       1       1       1       1       1       1
        1       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       2       2       1       2
        1       1       0       4       2       1       0       2       1
1       2       1       1       1       1       2       1       1       1       1       1
        5       1       1       1       0       1       4       4       1
4       1       2       2       2       2       2       2       1       2       1       2
        2       2       2       1       1       2       1       2       2
0       1       2       3       1       1       4       1       1       1       0       1
        1       1       2       2       2       2       1       1       2
2       2       2       1       2000    10000   8       30      1       3       1       1
        6       1       0       2       1       2       1
1       4       6       1       2       2       2       1       3       4       6       4
        5       5       3       6       6       6       5       8       4
3       5       1       1       1       3       4       1       1       1       1       2
        8       3       1       1       1       1       3       1       1
8       1       1       3       1       8       8       8       2       1       2       2
        2       2       0       1       1       42.5    13.82
14.54   30      115     70      164     78.1    36.3    29      298.34
2       3       153     3       2       2       3       3       3       2       3       2
        1       2       1       1       1       2       1       2       2
1       2       2       2       2       1       1       1       2       1       1       2
        1       1       1       3       1       2       1       2       2
1       3       1       2       3       1       5       5       5       1       3       1
        1       1       5       5       5       2       .       .       2
4       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       2       2       3       2       2       1       1       1       0       2
        1       1       3       3       3       1       1       5       2
1       1       1       1       1200    .       6       15      5       4       1       2
        3       9       0       1       1       1       1       9
3       3       1       1       4       4       9       3       1       5       3       3
        3       2       1       2       3       3       8       7       2
```

```
1       1       3       1       1       8       1       2       2       4       5       9
        4       3       1       2       2       1       1       10      1
1       1       1       8       8       1       8       3       2       2       2       2
        2       0       1       22      42.75   14.22   8.08
37      111     63      170     101     44      34.9    329.79
2       5       154     4       1       1       1       2       1       1       2       1
        1       2       2       1       1       1       1       1       1
1       1       1       1       1       1       1       2       1       1       1       2
        1       1       0       0       1       1       1       0       1
1       1       1       2       1       1       2       1       5       1       1       1
        1       1       1       1       0       1       4       4       2
4       3       3       2       2       2       2       2       2       1       2       2
        1       1       1       1       1       1       1       2       2
0       1       2       2       2       2       3       1       1       1       0       1
        1       1       3       3       3       2       2       1       1
1       1       1       1       .       12000   8       45      2       2       1       1
        5       1       0       2       1       2       1       1
4       8       1       1       3       2       1       8       1       4       8       5
        8       6       4       4       8       3       8       2       1
8       1       2       1       3       8       1       2       2       1       2       1
        6       3       1       9       9       3       9       1       3
1       1       1       1       3       1       3       1       2       2       2       1
        2       0       2       7       42.25   14.1    27.77
27      138     79      176     68.3    25.2    22      465.26
2       3       156     4       2       2       2       2       2       1       1       1
        1       2       1       1       2       2       1       2       1
1       1       1       1       1       1       1       1       2       1       1       3
        1       1       1       1       2       2       1       1       1
1       1       1       1       1       1       1       1       5       1       1       1
        1       1       1       5       6       2       .       .       3
4       2       3       2       2       1       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       3       3       3       3       3       1       1       1       0       1
        1       1       2       1       1       1       2       1       1
1       3       2       2       1500    10000   7       30      4       3       1       1
        3       1       0       1       1       1       1
1       2       8       1       1       2       2       1       8       1       8       7
        1       4       3       2       4       4       2       8       1
1       2       1       2       1       1       1       1       1       2       1       7
        1       7       1       1       1       1       3       1       1
1       8       1       1       8       8       8       5       4       1       2       2
        2       2       0       2       11      34.5    11.93
29.84   41      116     67      156     70.9    35.3    29.1    359.07
2       5       157     3       1       1       1       2       3       1       1       1
        1       2       1       1       1       1       1       1       1
1       1       2       1       1       1       1       1       1       1       2       2
        1       1       0       1       2       0       0       1       2
2       1       3       1       1       1       1       1       1       1       1       1
        1       1       5       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       2       1       4       4       2       2       1       1       0       1
        1       1       1       1       1       1       1       1       1
1       3       3       1       1600    .       6       30      3       5       1       2
        5       1       0       4       1       3       1       1
5       3       1       1       1       1       1       7       3       8       6       1
        4       1       1       3       7       4       8       1       1
```

```
4       1       1       1       1       8       1       1       1       1       8       1
        5       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       1
        4       1       3       .       42.25   14.57   79.15
45      107     62      167.25          114.9   48.6    41.2    287.24
2       5       158     4       1       1       1       1       1       1       1       1
        1       1       2       1       1       1       2       2       1
2       1       1       1       1       5       1       1       1       1       1       1
        2       1       0       0       0       0       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       3
1       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       3       1       1       1       1       1       1       1       0       1
        1       1       2       1       2       2       2       2       1
1       2       2       1       1450    .       8       10      1       3       3       3
        3       1       0       2       1       1       1       1
2       1       1       1       1       1       1       3       3       3       1       1
        1       3       1       1       4       3       3       3       1
3       1       1       1       1       5       1       1       1       3       1       1
        3       1       1       1       1       1       1       1       1
1       1       1       1       1       2       1       0       1       2       2       1
        2       0       3       30      42      13.74   3.47
19      107     62      170     100.5   44      34.8    473.68
2       3       159     3       2       1       2       2       1       2       1       1
        1       2       1       1       2       3       3       2       1
2       3       1       1       1       1       1       1       2       2       2       2
        3       1       0       0       0       0       0       2       1
1       1       2       1       1       1       3       1       1       1       1       1
        1       1       1       5       2       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       3       2       3       3       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       3
5       2       2       2       1400    .       8       30      1       4       2       3
        2       1       0       3       1       2       1       1
5       4       3       1       1       1       1       3       1       4       3       3
        3       3       3       3       3       3       8       3       1
1       4       1       1       8       2       1       2       4       1       1       1
        4       1       1       3       3       1       1       1       1
1       1       1       1       1       1       1       0       2       2       2       3
        1       0       2       30      39      12.81   12.64
30      109     51      156     65.1    31.7    26.8    402.89
2       4       160     3       2       1       4       2       2       1       3       1
        1       2       1       1       1       1       1       1       2
1       2       2       1       2       2       1       1       1       1       2       2
        2       1       0       1       2       1       1       1       1
1       1       1       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
0       3       3       2       3       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       2       2       1       1       1       0       0       1
        1       1       2       1       3       1       3       1       3
3       2       2       2       1700    .       .       .       3       3       2       2
        4       9       0       1       1       1       1       1
2       3       1       1       1       1       1       4       2       6       2       2
        4       4       2       4       3       4       8       3       4
```

```
5       4       3       3       1       8       1       2       3       2       1       1
        7       3       1       1       1       4       1       1       1
1       1       1       1       1       5       1       0       1       2       2       1
        2       0       3       .       41.5    13.98   14.90
44      94      56      157     54.2    24.2    22      326.28
2       5       161     3       1       1       1       1       1       1       1       1
        1       2       2       2       1       1       1       1       1
1       1       2       2       2       4       2       1       2       2       2       2
        2       1       1       0       1       1       1       3       2
1       3       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       5       5       4       2       1       1       1       1       0       5
        5       1       2       2       2       2       2       1       1
1       1       1       1       .       .       8       0       5       6       5       1
        8       1       0       1       1       1       1       1       5
6       1       3       1       1       1       2       1       1       5       5       5
        4       6       6       6       7       8       3       1       1
1       7       1       4       3       1       1       1       2       1       1       1
        1       5       1       1       1       1       7       1       1
7       1       1       1       1       1       1       1       2       2       2       1
        0       3       41      39      12.44   2.58    46
95      47      152     45      17.7    19.5    483.89
2       3       162     3       2       2       3       4       3       4       4       1
        1       4       2       2       1       1       1       2       1
1       2       2       1       3       3       1       1       2       1       2       2
        1       3       1       2       3       1       0       3       2
1       1       3       1       1       1       4       1       5       5       1       1
        1       1       2       1       0       1       4       1       4
4       1       1       2       3       1       1       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       2       3       2       1       4       3       4       4       4       6       1
        1       1       1       1       3       2       3       4       2
2       1       1       3       .       2000    9       15      3       3       2       2
        1       1       0       1       1       1       1       1
1       1       1       1       1       3       1       5       1       5       5       1
        6       2       1       1       4       4       6       4       1
8       1       1       1       1       2       2       4       2       7       1       1
        5       4       1       1       1       2       2       1       4
4       1       6       1       1       4       1       0       2       3       2       1
        3       0       3       2       41.5    15.05   23.95
44      111     80      167     79      34.5    28.5    286.49
2       4       163     2       1       1       1       1       2       1       1       1
        1       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       2       2
        1       1       1       0       0       2       1       1       1
1       2       1       1       1       1       1       1       1       1       1       1
        5       1       1       1       0       2       .       .       2
4       2       2       2       2       2       2       2       1       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       1       2       2       1       1       1       1       0       1
        1       1       2       2       2       2       1       1       1
2       3       1       3       1400    12000   8       45      2       2       1       1
        4       1       0       2       1       1       1
1       4       2       1       1       1       1       1       6       1       4       4
        1       2       3       1       3       3       2       8       3
```

```
1       5       1       3       1       9       9       1       1       1       1       2
        1       5       1       1       1       1       1       1       1
1       8       1       1       8       8       1       1       0       2       2       2
        2       2       0       2       .       46.5    14.55
11.55   44      115     69      166     97.5    45.9    35.4    447.22
2       3       164     3       1       2       3       3       3       2       2       1
        1       2       1       1       1       1       1       2       1
2       4       2       1       2       3       1       1       2       1       2       2
        2       2       2       1       1       1       1       2       1
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       2       1       0       3       .       .       0
.       3       3       3       3       3       3       3       3       2       1       2
        1       1       2       2       3       3       3       2       2
0       1       3       1       2       2       2       1       1       1       0       1
        1       1       2       1       1       1       2       5       1
4       1       1       1       .       10000   7       30      1       1       1       1
        3       9       0       1       1       1       1       1
4       4       3       3       1       1       9       3       1       4       3       2
        6       2       2       3       8       3       8       1       1
1       1       1       1       1       8       1       1       1       1       1       9
        5       4       1       2       5       1       1       10      1
1       2       1       1       1       1       9       0       2       2       2       2
        2       0       1       .       42      14.25   5.11
42      108     69      179.5   94.5    41.3    29.2    362.05
2       4       165     3       1       2       2       2       2       3       1       1
        1       2       1       1       1       1       1       3       2
1       1       2       1       2       2       1       3       3       1       1       3
        2       1       1       3       0       2       1       1       2
1       2       2       1       2       1       1       1       1       1       1       1
        1       1       1       5       2       2       .       .       2
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       3       4       2       1       1       1       0       1
        1       1       2       1       1       1       3       1       2
3       1       1       1       2300    15000   6       30      5       2       2       1
        3       1       0       1       1       1       1
1       7       3       1       1       1       1       1       4       1       8       4
        4       3       4       5       6       8       5       8       3
1       3       1       1       1       1       6       1       1       3       1       1
        1       5       1       1       1       4       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        3       2       0       2       21      42.5    13.54
9.49    28      104     69      171     62.7    18.1    21.4    494.99
2       3       167     3       1       3       4       4       1       2       2       1
        1       4       2       2       2       1       1       3       2
3       4       1       1       1       1       1       1       3       3       2       4
        1       3       2       0       0       0       1       0       1
1       3       3       1       1       1       1       5       1       1       1       1
        1       1       1       1       1       0       2       .       .       0
.       3       3       2       2       3       3       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       1       2       1       1       1       1       1       0       1
        1       1       1       2       2       2       2       1       1
1       1       1       3       .       9000    8       15      6       6       3       4
        6       1       0       3       1       2       1       1
4       4       4       1       1       1       1       5       1       6       6       4
        4       2       4       4       5       7       8       6       1
```

```
2       1       1       1       6       8       1       2       1       6       1       1
        8       9       1       9       3       9       9       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       2       9       47.5    15.05   14.31
30      112     87      167     58.3    24.9    20.9    367.04
2       4       168     3       1       2       2       2       1       2       1       1
        1       2       2       1       1       1       1       2       2
1       1       2       1       2       1       2       1       2       1       2       1
        1       1       0       0       0       0       1       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        5       1       1       5       7       1       4       4       2
4       2       3       2       2       2       2       2       1       1       2       2
        2       2       2       2       2       2       2       2       2
0       2       5       3       3       2       2       1       1       1       0       1
        1       1       2       2       3       2       2       1       2
4       1       1       1       .       10000   9       45      2       5       1       4
        2       9       0       1       2       1       1       9
2       3       1       1       1       3       9       4       1       1       2       1
        3       3       1       2       3       4       8       1       1
2       1       8       1       8       1       1       1       3       2       2       9
        3       2       1       1       2       4       1       10      1
8       1       3       1       1       1       8       6       2       2       2       1
        5       0       3       .       45      14.48   23.92
37      114     71      163     73.6    32.9    27.7    366.82
2       4       169     3       2       2       1       1       1       1       4       1
        1       3       1       2       3       2       1       4       3
2       1       2       1       2       5       1       2       2       2       2       2
        1       1       0       0       0       1       0       .       2
1       1       1       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       2       2
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       3       2       4       2       1       1       1       1       0       5
        1       1       1       1       3       3       2       2       1
1       1       1       1       .       8000    8       30      2       5       3       2
        4       1       0       1       1       2       1       1
3       2       1       1       1       1       1       1       1       1       2       1
        2       2       1       3       1       3       6       1       1
4       1       1       1       3       8       1       1       1       1       1       1
        4       2       1       1       3       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       1
        2       0       3       19      40      12.68   6.38
20      104     74      161.5   59.2    25.7    22.7    410.79
2       4       170     4       2       1       2       2       2       1       1       1
        1       2       3       1       2       1       2       2       1
1       1       1       1       2       1       1       1       2       2       1       1
        1       1       0       1       0       0       0       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       2       2       2       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       1900    5000    8       30      2       2       1       1
        5       1       0       1       1       1       1
1       4       4       1       1       1       1       1       3       1       5       4
        4       4       2       2       2       3       2       6       2
```

1 4 1 1 1 1 7 1 1 2 1 6
1 6 6 1 1 1 1 1 1
1 1 1 1 1 1 1 1 0 1 2 2
2 2 0 2 24 43.5 14 9.46
35 114 73 172 72.9 28.6 24.6 398.86
2 4 171 3 2 2 1 4 2 3 3 2
1 3 2 1 2 2 2 3 4
2 2 2 2 2 2 2 2 2 2 2 2
2 4 3 2 1 1 1 . 2
2 2 2 0 1 1 1 1 1 1 1 1
1 1 1 0 0 2 . . 1
0 3 3 3 3 3 3 3 2 1 2
2 2 2 2 1 1 1 2 2
0 1 1 1 1 1 3 1 1 1 0 1
1 1 2 1 2 2 1 1 4
4 5 5 5 1900 27000 6 90 1 7 7 3
4 9 0 7 3 3 3
9 6 6 6 6 6 6 9 7 1 6 5
4 5 4 6 6 3 5 7 3
3 4 5 5 5 5 8 6 8 6 2 1
9 8 7 4 5 4 3 3 10
7 7 7 7 7 7 7 9 0 2 2 2
2 1 0 3 . 42 13.9 18.15
27 145 35 154 67.8 29 28.5 438.13
2 5 172 3 2 2 2 2 1 2 1 1
1 2 1 1 1 1 1 1 1
1 1 2 1 2 2 1 2 2 2 1 2
1 2 1 0 0 1 1 1 1
1 1 2 1 6 1 2 1 1 1 1 1
1 1 1 1 0 3 . . 0
. 3 3 2 2 2 2 2 2 1 2 2
2 2 2 2 1 2 1 2 2
0 1 5 3 2 2 2 1 1 1 0 5
1 1 1 1 1 1 2 2 4
4 1 1 1 . . 7 25 2 4 1 3
5 1 0 3 2 2 1 1 5
5 1 2 1 2 1 7 1 3 7 2 6
2 4 5 3 3 7 4 1 1
1 1 1 3 1 1 1 1 1 1 1 4
3 4 2 7 1 1 1 1 1
1 1 1 1 1 1 0 2 2 2 2 2
0 2 16 43 13.49 3.08 20
97 59 158.5 56.7 20.2 22.6 365.48
2 4 173 4 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 2 1
1 1 1 1 1 1 1 1 1 1 1 1
1 1 0 0 0 1 0 1 1
1 1 1 1 2 1 2 1 1 1 1 1
1 1 5 1 0 2 . . 2
0 1 1 2 2 2 2 2 2 1 2 2
2 2 2 2 1 2 2 1 1
2 1 2 2 1 1 1 1 3 1 0 1
1 5 2 2 2 2 2 2 1
1 1 1 1 . . 8 60 3 3 1 2
1 1 0 1 1 1 1 1 3
1 1 1 1 1 1 1 1 2 1 1 3
1 1 1 1 3 8 2 1 4

1 1 1 1 1 1 1 1 1 7 1 8
1 1 1 1 1 1 1 1 8
5 8 8 8 1 1 0 2 2 2 2 2
0 2 . 39 12.86 22.85 45
135 75 172 81.2 38.6 27.4 300.87
2 3 174 4 1 1 1 2 1 1 2 1
1 2 1 1 1 1 1 2 1
1 1 2 2 2 1 1 1 1 1 2 1
1 1 0 1 0 1 0 0 1
1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 3
1 2 3 2 2 2 2 2 2 2 2 2
1 1 2 2 1 1 1 2 2
0 1 1 1 2 2 1 1 1 1 0 1
1 1 2 2 2 2 1 1 1
3 1 1 5 1800 12000 7 45 1 1 1 1
3 1 0 1 1 1 1
1 5 4 1 2 1 3 1 6 2 6 5
4 4 4 3 1 5 5 8 2
1 8 1 1 1 1 8 1 3 1 3 1
1 8 1 1 1 1 4 1 1
1 4 1 1 1 1 1 1 0 2 2 2
2 2 0 2 5 36.5 10.68
-0.77 38 103 64 168 73.9 32.6 26.2 327.63
2 4 175 3 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 2 1 1 1
1 1 0 0 0 0 0 0 1
1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 1
4 3 3 3 3 3 3 3 3 1 2 2
2 2 2 2 2 2 2 1 2
0 1 2 1 1 1 1 1 2 1 0 1
1 1 2 2 2 2 2 2 1
1 1 2 . . . . 4 3 1 1 4
1 0 4 1 1 1 1 4 4
1 1 1 1 1 2 4 4 1 1 1 3
1 1 1 4 8 1 1 1 1
1 1 1 1 1 1 4 1 1 1 3 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 0 3 3 3 1 5 0
3 . 42 13.5 0.38 20 115
62 164.4 70.8 30.6 26.2 505.05
2 4 177 4 1 1 1 1 1 2 1 1
1 3 2 1 1 1 1 2 1
1 3 3 2 1 1 3 1 1 1 2 3
1 1 1 1 0 0 1 1 1
1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 1
4 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 2 2 2 1 2
0 2 2 1 2 1 4 1 5 0 8 1
1 1 2 1 2 2 2 2 1
1 1 1 2 2000 . 7 40 6 2 1 1
4 9 0 1 1 1 1 1
1 1 1 1 1 2 1 1 1 8 2 1
1 1 1 1 1 1 3 8 1 1

8 1 1 1 1 4 1 1 6 3 1 1
1 3 1 1 6 1 2 1 1
1 1 1 1 1 1 1 0 1 2 3 2
2 0 2 1 44 13.65 9.64
22 131 77 170.1 58.5 23.7 20.2 379.64
2 5 178 3 1 2 1 1 1 1 1 1
1 2 1 1 1 3 1 1 1
1 1 1 1 1 1 1 1 1 1 1 2
1 2 0 0 1 1 1 0 2
1 1 2 1 1 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 0
. 2 2 2 2 2 2 2 2 2 2 2
2 2 2 2 1 1 1 2 2
0 2 3 1 1 1 2 1 1 1 0 1
1 1 2 2 2 1 1 2 1
3 1 1 2 2000 3000 7 45 1 1 1 1
3 1 0 1 1 1 1
1 1 1 2 1 1 1 1 2 3 6 3
1 8 1 6 8 8 1 8 1
1 8 8 1 1 8 8 1 1 1 1 1
1 6 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 0 1 1 1
1 2 0 2 30 43.5 12.99
15.66 22 104 72 159 53.4 18.5 21.1 461.08
2 3 179 4 2 3 4 3 3 5 4 2
1 3 2 3 2 2 2 2 1
2 3 2 3 3 4 2 2 3 5 2 4
3 1 1 0 0 1 2 0 2
1 2 2 1 1 1 1 1 1 1 1 1
1 1 1 1 0 3 . . 0
. 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 3 2 2 2 2
0 2 1 1 3 2 2 1 1 1 0 1
1 1 3 2 2 2 2 3 1
2 2 2 2 1250 10000 8 20 4 3 1 4
4 1 0 1 2 2 1
1 1 3 1 1 1 1 1 1 1 5 4
1 3 2 3 6 2 3 8 3
3 2 1 1 1 2 1 1 1 4 1 4
1 4 4 1 1 3 1 1 1
1 1 1 1 1 1 1 1 0 1 2 2
3 2 0 2 20 48 14.78 12.69
24 131 82 184.2 70.5 31 20.8 587.01
2 3 180 4 1 1 2 2 2 1 1 1
1 2 1 1 1 1 1 1 1
1 1 2 1 1 1 1 1 1 1 1 1
1 1 0 1 0 0 1 2 1
1 1 1 1 1 1 5 1 5 1 1 1
5 1 1 1 0 2 . . 1
4 2 2 2 2 2 2 2 1 1 2 2
2 2 2 2 1 2 2 2 1
0 1 2 1 1 2 1 1 1 1 0 5
1 1 2 2 2 2 2 2 2
2 1 1 2 . 5000 7 20 2 4 1 1
1 1 0 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 2 1
2 3 1 1 1 3 8 1 1

```
4       1       1       1       1       8       1       1       1       5       4       4
        5       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       2       2       2       1
        4       2       2       60      41.5    12.33   13.55
36      135     79      166     72.5    33.7    26.3    387.54
2       4       181     3       2       3       5       5       3       2       5       1
        1       2       2       2       3       3       1       3       3
4       2       3       3       3       4       2       2       3       2       2       3
        2       4       2       1       1       1       2       2       2
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       3       3       2       2       2       2       2       2       2       1       2
        1       1       2       1       1       1       1       2       2
0       2       2       2       2       2       2       1       1       2       6       1
        1       1       2       2       2       2       2       3       1
3       1       1       1       2000    10000   7       15      1       1       1       1
        2       1       0       1       1       1       1
1       5       5       5       4       1       1       1       5       1       4       3
        3       4       2       4       5       5       5       8       3
1       1       5       5       5       6       6       1       1       1       2       1
        1       7       2       1       1       4       1       1       1
1       1       1       1       1       1       1       1       0       1       3       2
        2       2       0       1       22      43.5    13.7
5.50    19      108     70      162.5   55.9    18.7    21      420.77
2       3       182     4       2       1       2       2       2       2       1       1
        1       2       1       1       2       3       1       1       1
1       1       2       2       2       5       1       2       1       1       1       2
        1       1       3       2       1       0       1       1       1
2       1       1       1       2       5       1       1       1       1       1       1
        1       1       1       5       2       2       .       .       3
2       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       1       2
0       2       2       2       3       1       2       1       2       1       0       1
        1       1       2       2       2       2       1       1       1
3       1       1       1       1800    35000   8       155     3       4       1       1
        2       1       0       1       1       1       1
1       1       8       1       1       1       1       1       2       1       3       1
        1       6       5       3       2       5       3       8       1
1       8       1       1       1       1       1       2       1       4       1       3
        1       8       8       1       3       3       2       2       1
1       1       1       1       1       1       1       8       1       1       2       2
        3       2       0       3       10      45      14.14   15.89
25      129     78      170     70.5    25.3    24.4    414.73
2       4       183     2       2       2       3       3       5       4       1       1
        1       3       2       1       2       3       0       5       4
2       1       2       2       2       1       1       1       4       2       1       2
        1       1       0       3       1       1       2       4       1
1       4       2       1       5       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       2       2       2       2       2
0       3       3       4       2       3       2       1       1       1       0       1
        1       1       2       1       3       1       3       5       1
1       1       1       5       .       4500    5       .       5       3       1       4
        4       1       0       1       1       1       1       1
1       6       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       1       3       7       1       1
```

```
3       1       1       1       1       1       8       1       1       8       1       1
        1       1       1       4       4       1       1       1       1
1       1       1       1       1       1       1       0       1       3       2       2
        2       0       2       22      43.5    13.64   4.64
43      145     100     166.5   81.4    37.5    30.2    370.47
2       3       184     4       1       1       2       2       1       2       1       1
        1       2       1       1       1       1       1       1       1
1       2       1       1       1       1       1       1       1       1       2       2
        1       1       1       1       0       0       1       0       2
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       2       3
4       2       2       2       2       2       2       2       2       2       1       2
        1       1       2       2       1       1       1       2       2
0       2       2       1       2       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
5       2       1       5       1500    10000   8       30      1       1       1       1
        3       1       0       1       1       1       1
1       3       4       1       1       1       1       1       3       1       5       1
        3       2       1       1       1       8       1       8       1
1       1       1       1       2       1       8       1       1       2       1       4
        1       7       1       1       1       1       1       1       1
8       1       1       1       1       1       8       1       0       1       2       2
        1       4       1       4       .       43.5    14.11
12.61   27      136     84      166.5   56.7    18      20.3    325.99
2       5       185     3       2       2       1       3       2       1       1       1
        1       3       1       1       1       2       1       3       3
1       1       2       1       2       1       1       1       1       2       2       2
        2       1       3       1       2       0       1       0       2
1       3       2       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
0       1       1       2       3       1       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       2       2       2       2       2       1       1       1       0       2
        1       1       2       2       2       2       2       5       2
2       2       2       2       1300    9000    6       30      2       4       2       1
        2       1       0       2       2       1       1
1       2       2       1       1       1       1       1       1       1       3       5
        1       1       1       2       2       2       2       8       1
1       1       4       1       1       4       3       1       1       2       1       2
        1       2       2       1       1       1       1       1       1
1       6       1       1       1       1       1       1       0       1       2       2
        2       2       0       1       18      41      12.24   3.70
43      127     81      166.5   67.8    31.7    24.3    421.66
2       2       186     4       2       1       3       2       2       1       2       1
        2       2       2       1       1       1       1       2       1
2       3       2       2       2       1       2       2       2       2       2       2
        2       2       2       0       0       1       1       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       1       3
2       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       1       2
0       1       2       2       2       3       3       1       3       0       0       2
        1       1       2       2       2       2       2       1       1
2       2       2       2       1450    7500    9       60      3       2       4       1
        6       1       0       1       1       1       1
1       5       6       1       1       8       6       1       1       1       5       3
        1       5       5       2       2       2       2       8       1
```

```
1       1       1       8       8       1       8       1       2       3       1       1
        1       4       3       1       1       4       1       1       1
1       8       1       1       1       8       8       1       0       1       1       3
        3       2       0       2       9       41.5    12.73
3.63    40      99      61      154.6   60.5    21.8    25.2    434.03
2       3       187     2       2       2       3       2       3       3       2       1
        1       1       1       1       1       1       1       2       2
1       2       2       2       2       2       3       2       2       3       4       3
        3       2       2       2       1       1       1       0       1
1       1       3       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       4       2       4       3       2       3       1       1       0       1
        1       1       2       1       3       3       3       5       1
2       2       1       1       2000    .       6       60      3       3       1       2
        1       1       0       1       1       1       1       1
2       1       1       1       1       1       1       1       1       3       1       1
        3       5       1       4       5       3       8       3       1
5       1       1       1       2       3       1       2       3       2       5       1
        1       3       1       1       1       2       1       1       1
1       1       1       1       1       1       1       0       2       3       2       2
        2       0       2       .       41      13.14   9.80
36      99      62      161.5   89.9    43.2    34.3    345.14
2       4       188     2       4       4       4       4       4       4       2       1
        1       4       1       2       2       1       1       3       3
3       3       2       1       3       2       2       2       4       2       1       4
        1       1       4       3       1       1       0       1       2
1       2       2       1       1       1       1       1       5       1       1       1
        1       1       1       1       0       2       .       .       0
.       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       1       4       4       2       1       3       1       0       1
        1       1       1       1       1       1       2       2       0
0       2       4       4       1400    7000    7       30      4       1       1       1
        1       1       0       1       1       1       1
1       1       5       1       1       1       1       1       1       1       5       3
        3       3       2       2       4       1       4       8       1
1       2       1       1       1       1       1       1       1       1       8       1
        1       6       5       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       3       1
        1       4       1       4       .       45.5    15.09
47.72   20      118     78      161     71.5    35.1    27.6    359.15
3       4       189     3       2       2       1       3       2       3       4       1
        1       3       2       1       1       1       3       3       1
1       1       2       3       3       1       1       1       2       1       3       4
        3       1       2       0       0       0       0       1       2
1       1       2       2       1       1       3       1       1       1       1       1
        1       1       1       5       2       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       2       2       2       2       2       4       1       1       1       0       1
        1       1       2       1       1       1       2       1       2
2       2       1       1       1600    10000   6       45      1       3       1       2
        4       1       0       3       1       1       1
1       3       4       1       1       2       4       1       7       5       3       2
        6       7       1       8       8       8       3       8       2
```

```
1       1       1       1       1       1       8       1       1       2       1       1
        1       4       3       1       3       2       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       49      36.75   13.65
3.26    22      115     75      167     60.8    19.5    21.8    436.20
3       5       190     3       2       2       1       2       2       2       1       1
        1       2       1       1       1       1       1       2       1
1       2       2       1       2       1       1       2       2       1       1       3
        2       2       1       2       0       1       1       0       2
1       2       1       1       1       1       1       1       1       1       1       1
        1       1       1       5       2       2       .       .       0
.       2       3       2       2       3       3       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       3       2       2       2       2       1       1       1       0       1
        1       1       1       1       1       2       2       1       1
2       1       1       1       1500    10000   7       60      3       3       1       2
        5       1       0       2       1       1       1
1       4       5       1       1       1       1       1       5       1       4       5
        1       8       4       3       3       5       3       8       1
1       1       5       1       1       1       8       1       1       2       1       1
        1       6       1       1       1       3       1       1       1
1       1       8       1       1       1       1       1       0       1       2       2
        1       2       0       2       11      40.75   13.76
-0.05   23      109     76      160     58.2    22.8    22.7    351.40
3       4       191     3       2       1       2       3       3       2       2       1
        1       3       1       2       1       2       1       2       2
2       1       2       2       2       3       2       2       2       2       2       3
        2       1       2       2       2       0       1       4       1
1       2       1       1       1       1       1       1       1       1       1       1
        1       1       1       5       4       1       1       1       2
0       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       2       2       1       1       1       3       1       1       1       0       1
        1       1       2       1       1       1       3       4       2
2       1       1       1       .       .       8       .       4       4       1       6
        3       1       0       1       1       1       1       1       4
3       1       1       1       3       1       1       1       4       4       1       3
        4       1       1       5       5       8       3       3       1
1       3       1       3       6       1       1       3       1       1       1       6
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       1       2       2       3       2
        0       1       .       37      11.73   0.15    27
99      68      155.5   58.7    28.5    24.3    356.24
3       4       192     3       2       1       2       2       2       3       3       3
        1       2       2       1       3       2       1       2       1
2       1       4       2       3       3       2       2       1       1       2       2
        2       3       0       0       1       0       1       0       1
1       1       1       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       1       2       2
0       2       1       1       3       1       3       1       2       0       0       1
        1       1       2       3       3       3       2       2       2
3       1       1       1       .       .       7       .       1       1       1       3
        6       9       0       1       1       1       1       9       3
1       4       7       1       1       9       2       1       2       2       5       4
        2       1       6       6       2       8       2       1       3
```

```
3       1       1       1       1       1       1       1       1       1       1       5
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       2       2       2       2       2
        0       2       .       42.5    15.15   10.08
28      88      50      161     66      30.2    25.5    284.11
3       5       193     3       1       2       3       3       1       2       3       1
        2       2       2       1       2       4       3       3       3
1       3       2       2       2       1       1       2       2       2       2       2
        2       3       1       0       1       0       2       1       1
1       1       1       1       1       0       4       1       1       1       1       1
        1       1       1       0       0       1       4       5       1
0       4       2       2       2       2       2       2       2       1       2       2
        1       1       1       1       1       2       1       2       2
0       1       1       1       1       1       1       1       1       5       6       1
        1       2       2       2       2       2       2       1       1
5       3       1       1       2000    5000    7       30      2       2       1       7
        5       9       0       3       1       3       1
9       3       3       4       4       3       1       9       4       1       2       2
        1       4       2       2       5       9       2       8       1
1       4       1       5       1       2       1       1       1       1       1       1
        9       2       1       1       1       4       1       1       10
1       1       1       1       1       1       1       9       0       3       3       3
        3       2       0       4       30      39.75   14.3
27.31   33      95      62      154.5   55.1    23.9    22.9    250.85
3       4       194     4       1       1       1       2       1       1       1       1
        1       2       1       1       1       1       1       1       1
1       1       3       1       1       1       1       1       1       2       1       1
        1       1       1       0       0       1       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       3
4       1       1       1       1       1       1       1       1       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       1       1       1       1       2       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
3       1       1       1       .       300     6       20      3       3       1       1
        4       9       0       3       1       2       1       9       3
2       1       1       1       1       9       7       1       7       1       3       8
        3       4       3       4       4       8       1       1       7
1       1       1       4       8       1       3       2       1       1       9       3
        1       1       1       3       1       1       10      1       1
1       1       1       1       1       9       0       2       2       3       2       2
        0       3       4       42      14.08   23.33   30
108     68      163.5   51.9    15.7    19.4    459.57
3       5       195     3       1       2       1       2       1       1       1       1
        1       1       1       1       1       2       1       1       1
1       1       2       2       2       1       2       1       1       1       2       2
        1       1       0       0       0       0       0       0       1
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
4       2       1       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       .       4500    8       10      2       2       1       5
        4       9       0       1       1       1       1       9
4       2       3       2       1       1       9       2       1       1       2       5
        9       2       1       5       9       2       8       2       1
```

```
2       1       1       1       3       1       1       1       1       1       1       1
        2       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       3       2       2       2
        3       0       2       .       43.25   14.08   50.69
25      102     56      154     52.1    17.9    22      301.78
3       3       196     3       1       2       2       2       1       1       1       1
        1       2       1       1       1       1       1       2       2
2       1       2       1       1       1       1       1       2       1       1       2
        1       1       3       0       0       0       1       3       1
1       1       1       1       1       1       5       1       1       1       1       1
        1       1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
2       1       2       2       2       1       1       1       1       5       8       2
        2       5       3       3       3       3       3       2       5
5       2       2       2       .       .       .       .       2       2       1       1
        1       1       0       1       1       1       1       1       4
1       1       1       1       1       1       1       1       1       4       6       3
        1       5       4       8       3       8       2       1       1
1       3       1       4       2       1       2       3       1       1       1       1
        1       5       1       1       1       1       1       1       1
1       1       1       7       1       1       0       1       2       2       2       2
        0       2       10      44      15.25   21.70   23
102     69      160     59.5    25.3    23.2    377.01
3       3       197     4       2       2       2       2       2       2       2       1
        1       1       1       1       1       1       1       2       1
1       1       1       1       1       1       1       1       2       3       3       3
        1       1       0       0       1       0       0       0       1
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       1       0       1       2       1       4
1       2       2       2       2       1       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       2       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       2
2       3       1       1       1500    .       7       .       3       3       1       1
        3       1       0       1       1       1       1       1
3       2       1       1       1       1       1       3       1       3       8       1
        8       1       6       3       5       1       8       8       1
8       1       1       1       1       1       1       1       1       1       1       1
        4       4       3       3       1       4       1       1       3
6       1       1       1       1       1       1       0       2       2       2       1
        2       0       2       2       40.25   12.3    0.55
47      122     78      161     74.7    36      28.8    362.58
3       4       198     2       1       2       4       4       1       2       1       1
        2       2       1       1       1       1       4       2       1
4       1       2       1       1       2       1       0       2       2       3       3
        1       4       2       3       1       1       1       0       2
1       4       2       1       2       1       1       1       5       1       1       1
        1       1       1       1       1       0       1       4       1       4
4       3       1       2       2       2       2       2       3       2       1       2
        1       1       2       2       1       1       1       2       2
0       2       1       1       1       1       5       1       1       5       9       1
        1       1       2       2       2       2       2       1       1
5       1       1       1       2000    5000    10      15      2       1       1       1
        1       1       0       1       1       1       1
1       6       6       3       4       3       2       1       2       1       4       5
        5       8       5       8       6       8       3       8       4
```

```
1       6       8       1       8       2       3       1       2       1       1       1
        1       8       9       8       3       8       1       1       1
6       1       3       1       1       2       2       1       0       2       2       3
        2       2       0       2       46      48.25   16.38
12.04   34      95      65      168     54.4    21.5    19.3    364.05
3       4       199     2       1       1       2       2       1       1       5       2
        1       3       2       2       1       1       2       2       1
1       3       1       1       1       2       3       3       1       1       2       2
        1       2       1       1       0       1       0       1       2
1       1       2       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       3       3       2       2       2       2       2       2       1       3       2
        2       2       2       2       1       1       1       2       2
0       2       3       3       3       3       2       1       1       2       0       2
        1       1       2       2       2       1       2       2       1
2       1       1       1       2000    10000   7       120     1       3       1       1
        4       1       0       1       1       1       1
1       1       4       1       1       4       6       1       1       1       6       4
        4       4       1       4       4       4       4       8       4
4       4       1       1       1       1       8       1       1       1       1       1
        1       8       4       1       4       4       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       2       0       2       23      41      14.38   23.12
19      115     63      162     52      14.8    19.8    394.37
3       4       200     3       1       1       4       2       2       1       2       2
        1       2       1       1       1       1       1       1       1
2       2       1       1       1       2       1       1       1       1       3       3
        1       3       1       0       0       0       1       0       2
1       2       1       1       4       1       1       1       2       1       1       1
        1       1       1       1       1       0       3       .       .       1
4       3       3       2       2       2       2       2       2       1       1       2
        2       2       2       2       1       2       1       1       2
0       1       1       2       1       1       1       1       5       1       0       1
        1       1       2       2       2       1       2       2       1
1       1       1       1       .       .       .       .       2       1       1       1
        4       1       0       3       1       1       1       1       2
4       1       2       1       1       1       1       1       4       2       2       1
        3       4       4       4       2       8       1       1       8
1       1       1       3       1       1       3       6       1       1       1       4
        2       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       2       20      43      13.94   8.31    27
94      50      160.1   55.1    21.3    21.5    410.42
3       4       201     3       2       1       2       3       2       1       2       1
        1       2       1       1       1       2       1       2       2
2       2       1       1       2       1       1       1       2       1       1       2
        1       1       0       2       0       3       2       3       2
1       5       5       2       2       1       5       1       1       1       1       1
        1       1       1       5       8       3       .       .       0
.       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       1
5       1       3       1       4       4       2       3       2       1       0       1
        5       1       2       1       3       2       3       1       1
3       1       1       1       .       .       8       .       3       4       3       1
        7       1       0       1       1       1       1       1       3
6       1       1       1       2       1       1       3       7       2       1       3
        2       1       3       3       2       8       1       1       4
```

```
1       1       1       3       1       1       1       1       1       1       1       1
        1       6       2       1       9       9       1       1       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       2       30      47.25   14.36   6.32
25      101     64      170.5   68      31.1    23.4    383.80
3       5       202     3       1       1       1       1       2       1       2       1
        1       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       2       2       1       1
        1       1       0       1       0       2       .       .       1
1       1       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       1       0       2       .       .       3
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       1       1       2       2       2       1       1       1       0       1
        1       1       2       1       1       1       2       2       1
1       1       1       1       2200    3000    7       30      4       3       1       2
        1       1       0       2       1       1       1
1       3       3       1       1       1       1       1       4       1       6       3
        2       3       2       2       2       5       6       8       7
7       4       1       1       1       1       1       1       1       5       5       1
        1       3       5       1       5       1       1       5       1
1       1       1       1       1       8       1       1       0       1       2       1
        1       2       0       2       4       42.75   14.22
12.22   34      160     98      165.5   93.7    46.2    34.2    422.15
3       6       203     3       2       2       3       2       3       2       2       1
        1       3       2       1       2       2       1       2       1
2       2       2       2       2       2       3       1       2       3       2       3
        2       2       1       1       2       1       1       1       1
1       1       1       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       1       0
.       3       3       2       2       3       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       2       2       2       4       2       2       1       0       1
        1       1       1       1       1       1       1       2       2       1
2       2       2       1       1500    5000    6       0       2       5       3       1
        1       1       0       1       1       1       1
1       2       3       2       1       1       1       1       5       4       4       3
        1       4       3       2       2       3       3       8       1
1       5       1       1       1       1       1       1       1       1       8       1
        1       3       4       1       1       4       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       15      48.25   12.24
3.37    30      119     81      160.1   90.2    44      35.2    371.84
3       4       204     3       1       1       2       2       1       1       1       1
        1       2       1       1       1       2       1       1       1
1       1       1       2       2       1       1       1       1       2       1       1
        1       1       1       1       0       0       1       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
0       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       2       2       2       2       2       5       1       0       1
        1       1       2       3       3       1       2       1       2
2       1       1       1       .       3000    7       15      3       2       1       2
        3       1       0       1       1       1       1       1
1       3       1       1       1       1       1       1       1       2       1       4
        3       2       1       3       3       2       5       1       5
```

```
4       1       1       1       1       1       1       1       2       5       1       1
        4       1       1       1       1       1       1       1       1
5       1       1       1       1       1       1       0       2       2       2       2
        4       1       4       .       42      13.94   22.22
43      113     73      167     68.7    33.3    24.6    307.72
3       3       205     3       2       2       2       2       3       4       4       5
        1       2       2       2       1       2       2       4       4
1       2       2       5       3       2       2       2       3       1       2       2
        1       2       0       0       0       1       0       0       1
1       2       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       1       2
3       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       2       1       1       2       1       3       1       0       1
        1       1       2       2       2       2       3       4       1
1       1       1       1       .       .       10      0       5       2       2       1
        2       1       0       1       1       1       1       1       2
1       1       1       1       1       1       1       1       6       1       3       3
        1       1       1       1       7       3       6       1       6
1       1       1       4       3       2       1       1       1       1       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       2       49      37.75   12.87   14.40
19      110     77      159     86.6    40.3    34.3    340.82
3       3       206     2       2       2       5       3       5       2       3       3
        1       4       2       2       1       4       1       2       2
4       2       4       2       3       1       3       4       2       1       3       3
        3       4       1       0       0       1       2       2       1
1       2       2       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       1       1       999
1       3       3       2       2       2       3       2       3       1       2       2
        1       2       2       2       1       2       1       1       2
0       2       4       2       5       3       1       1       3       4       10      1
        1       1       2       1       1       1       2       2       2
3       2       2       2       1300    .       8       30      5       3       4       5
        1       1       0       1       1       1       1       1
1       3       1       1       5       3       1       4       1       4       1       1
        5       3       2       4       6       1       8       1       1
6       1       1       1       1       1       5       1       1       1       8       1
        7       7       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       2       2       2       2
        1       0       3       .       39      13.55   49.85
41      117     67      153     108.4   44.8    46.3    324.39
3       4       207     2       1       2       4       5       3       1       4       4
        1       5       4       4       2       2       1       2       1
4       1       5       5       4       1       5       5       2       1       2       5
        1       1       3       0       0       2       1       2       3
1       1       1       1       2       1       4       1       1       1       1       1
        1       1       1       5       9       2       .       .       0
.       1       1       2       2       2       2       2       2       1       1       2
        2       2       2       2       2       2       2       1       2
0       1       1       3       4       3       3       1       5       5       10      1
        1       1       2       2       2       2       2       2       1
1       1       2       1       .       5000    9       30      4       5       2       1
        5       1       0       1       1       1       1       1
3       1       1       1       1       1       1       5       1       8       4       1
        4       1       1       4       2       4       6       2       1
```

7 1 1 1 1 3 3 1 5 7 1 1
4 4 1 1 4 2 2 1 1
1 1 1 1 1 1 1 0 1 2 2 2
1 0 1 2 40.75 12.95 7.67
26 102 67 165 79.4 34.5 29.2 427.63
3 2 208 2 1 1 1 2 3 1 1 1
1 1 2 1 1 1 1 1 1
1 1 1 1 1 1 1 2 2 1 2 1
1 1 1 3 1 1 0 1 1
1 4 1 1 4 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 1
4 1 1 1 1 1 1 1 1 1 2 2
2 2 2 2 2 2 2 1 2
0 1 5 2 1 3 2 1 5 5 10 1
1 1 2 1 1 1 3 1 1
1 1 1 1 . . 6 30 3 4 1 2
4 1 0 2 1 1 1 1 2
4 1 1 1 1 1 1 1 8 2 1 3
1 2 2 2 6 3 2 1 8
1 1 1 1 1 3 1 1 5 1 1 4
1 1 1 3 1 1 1 1 1 1
1 1 1 1 1 1 0 1 2 3 2 2
0 3 11 42.5 13.75 25.49
26 114 69 168.5 82.2 37.2 29 342.21
3 4 209 3 1 2 1 2 1 5 1 2
1 2 2 1 1 1 1 1 1
1 1 2 1 1 1 1 1 2 1 3 5
1 2 0 0 1 0 1 1 1
1 1 1 1 1 1 2 1 1 1 1 1
1 1 1 1 5 2 2 . . 1
4 2 2 2 2 2 2 2 2 2 2 2
1 1 2 2 1 2 1 2 2
0 1 5 5 2 1 1 1 1 1 0 1
1 1 2 1 1 2 2 1 1
2 2 3 5 2000 12000 6 30 1 1 1 1
8 1 0 1 1 1 1
1 4 8 2 2 2 6 1 3 2 8 8
1 3 1 5 5 5 3 8 1
1 8 1 1 1 1 1 1 1 4 1 1
1 8 2 1 2 1 1 1 1
1 1 1 8 1 1 1 8 0 2 2 2
1 2 0 3 5 44.5 14.82
9.21 39 111 71 165.8 63.3 23.6 23 379.71
3 4 211 3 1 1 2 3 1 1 2 1
1 3 2 1 1 1 1 4 2
1 2 4 1 2 1 1 1 1 2 2 2
2 1 1 1 1 2 . 0 1
1 1 1 1 1 1 5 1 5 5 1 1
1 1 1 1 1 0 2 . . 0
. 3 3 2 2 2 2 2 2 1 2 2
2 2 2 2 1 2 1 1 2
0 2 4 3 4 1 5 1 5 2 6 1
1 1 2 2 2 2 2 1 1
2 2 1 1 1500 12000 7 15 3 6 1 1
2 1 0 1 1 1 1
1 1 2 1 1 1 1 1 1 1 3 8
1 5 2 3 3 1 2 8 1

```
1       8       1       1       1       1       5       1       1       1       1       1
        1       1       1       1       1       1       6       1       1
1       8       1       4       1       1       1       1       0       1       2       2
        2       2       0       1       .       41.75   12.84
14.91   42      100     63      161.3   57.5    27.7    22      361.89
3       3       212     3       2       1       3       4       2       1       1       1
        1       5       2       1       1       2       1       2       1
2       2       2       2       2       1       1       1       2       1       3       3
        4       3       1       1       1       1       1       0       2
1       2       1       3       2       1       1       5       5       1       1       1
        1       1       1       1       0       1       4       1       1
4       1       1       2       3       2       2       2       1       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       5       5       5       5       5       2       1       1       0       1
        1       1       2       2       2       1       1       1       3
3       2       2       5       1640    4000    7       40      1       6       1       2
        3       1       0       1       1       1       1
1       3       4       1       1       1       5       1       4       1       3       2
        1       4       4       1       3       2       1       8       1
1       1       1       1       1       1       1       1       1       1       1       8
        1       4       1       1       2       3       1       1       1
1       1       1       1       1       1       8       8       6       1       2       2
        2       2       0       1       18      37      12      2.78
43      123     60      161     76.5    31.7    29.5    387.89
3       5       213     4       1       2       3       2       2       2       4       1
        1       4       1       1       2       1       1       1       1
1       2       3       3       3       1       2       1       2       1       1       2
        1       1       .       2       0       2       0       0       1
1       2       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       2       3       1       2       1       1       1       1       0       1
        1       1       2       1       1       1       2       1       4
3       4       4       5       1600    8000    5       35      1       3       1       2
        1       1       0       6       1       1       1
1       1       1       1       1       1       1       1       4       1       2       2
        4       4       1       1       3       1       1       8       1
2       4       1       1       1       1       6       1       1       3       1       6
        1       3       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       18      43.25   14.14
11.81   26      120     82      158     50.9    14.5    20.4    494.99
3       4       214     3       2       2       2       2       2       3       1       1
        1       1       1       1       1       1       1       1       1
2       1       1       1       1       1       1       1       3       2       1       3
        2       1       1       1       1       0       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       2       2       2       1       1       1       1       0       1
        1       1       2       2       2       2       2       2       1
2       2       1       2       1800    4000    7       30      2       3       1       1
        1       1       0       2       1       1       1
1       2       1       1       1       1       1       1       4       1       1       2
        2       3       4       2       3       3       1       6       2
```

```
1       2       1       1       1       5       5       2       2       2       1       5
        1       4       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       4       1       3       116     45      13.41   20.83
22      128     76      172     68.3    26.4    23.1    408.65
3       5       215     4       1       1       1       2       1       1       1       1
        1       2       2       1       1       1       1       1       1
1       1       2       2       2       1       1       1       2       1       2       2
        1       1       0       0       2       0       0       1       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
0       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       1       2       1       1       1       1       1       1       0       1
        1       1       1       2       2       2       2       1       5
5       1       5       3       .       .       7       .       2       3       1       1
        4       1       0       2       1       1       1       1       1
1       1       1       1       1       1       4       1       2       1       3       8
        1       4       6       6       1       8       1       1       2
1       1       1       1       8       1       1       8       1       8       1       8
        1       1       1       1       2       1       1       1       8
1       1       2       2       1       1       0       2       2       2       2       4
        2       2       5       39      12.4    26.88   58
93      55      165.5   60.4    22.6    22.1    346.22
3       3       216     4       1       1       1       2       2       2       1       1
        1       3       2       1       1       2       1       1       1
2       1       1       1       1       1       1       2       2       1       3       3
        1       1       0       0       1       1       0       1       2
1       2       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       1       2       2       4       1       1       1       0       1
        1       1       2       1       1       1       1       1       1
4       2       2       2       1700    .       8       45      5       4       2       1
        8       2       1       3       1       1       1       1
1       2       1       1       1       1       1       1       3       6       3       1
        2       6       8       8       8       3       8       1       1
1       1       1       1       1       8       1       7       3       1       3       1
        2       2       2       2       2       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       1       2       41.75   12.56   26.94
29      118     63      167     75.6    29.2    27.1    328.86
3       4       217     3       2       2       3       4       2       1       2       1
        1       3       1       1       2       1       1       1       1
3       1       1       1       2       1       1       1       2       1       1       2
        2       1       0       0       1       0       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       2       2       2       2       2       2       3       2       1       2
        1       1       2       2       1       1       1       1       2
0       1       2       1       2       2       1       1       5       5       9       1
        1       1       2       2       2       2       2       2       2
4       1       1       1       .       10000   7       15      1       1       1       1
        1       1       0       1       1       1       1       1
1       5       1       1       1       6       1       5       4       8       3       1
        1       2       4       1       3       1       8       8       2
```

```
8       1       1       1       4       1       1       1       2       1       9       9
        6       9       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       2       2       2       1
        2       0       2       7       44.25   14.05   -0.63
22      122     78      168.2   67.7    31.5    23.9    586.65
3       3       218     3       1       2       1       1       2       2       1       1
        1       2       2       2       1       1       1       2       2
1       1       1       1       1       1       1       1       2       2       1       2
        1       1       2       0       1       2       0       4       2
1       4       1       1       6       1       2       5       5       1       1       1
        1       1       5       5       10      2       .       .       0
.       2       2       2       2       3       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       1
4       1       3       3       1       1       1       1       1       1       0       1
        1       2       1       2       2       2       2       2       1
2       1       1       2       1800    .       8       20      1       6       1       1
        3       2       0       1       1       1       1       1
1       3       1       1       1       1       1       6       1       4       3       1
        1       1       5       3       3       1       8       4       1
3       1       3       1       5       3       1       1       1       8       1       1
        5       1       1       3       3       1       1       1       1
1       1       1       1       1       1       1       0       1       1       2       2
        2       0       2       20      39.25   12.38   13.89
22      128     84      152     48.3    14.7    20.9    396.15
3       5       219     3       2       1       1       1       1       1       2       2
        1       1       1       1       2       1       1       1       1
1       2       2       3       2       1       2       1       1       1       2       1
        1       1       0       1       0       1       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
0       2       3       2       2       3       3       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       2       2       2       1       2       0       0       1
        1       1       1       2       2       2       2       1       2
5       2       1       1       2000    6000    7       45      4       6       4       1
        5       9       0       2       1       1       1
9       1       5       2       1       6       6       9       1       1       5       2
        1       5       2       1       2       5       1       8       1
1       1       1       7       1       1       3       1       1       1       2       5
        9       1       1       1       1       1       1       1       10
1       1       1       1       1       1       1       9       0       1       2       2
        2       2       0       2       9       42.25   13.45
2.50    26      104     61      165.5   94.5    39      34.5    325.85
3       4       220     3       1       1       2       4       3       1       2       1
        1       3       1       1       1       1       1       2       1
3       1       1       1       2       1       1       1       2       2       2       2
        1       1       .       .       .       1       1       3       3
1       1       2       1       1       1       2       1       1       1       1       1
        1       1       1       5       2       1       4       1       3
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
5       3       3       3       3       3       3       2       1       1       0       5
        5       1       2       1       1       1       3       1       2
5       1       1       1       2000    .       6       20      3       3       1       2
        3       1       0       2       1       1       1       1
3       3       1       1       2       2       1       2       2       4       3       2
        6       6       6       6       6       2       8       1       1
```

```
1       1       1       4       4       7       1       3       3       1       3       1
        1       1       4       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       3       1
        2       0       2       33      43.25   13.77   0.56
23      114     65      156     63.5    25.3    26.1    412.95
3       4       222     2       3       3       3       3       2       5       4       5
        2       5       2       2       3       4       1       4       3
3       4       3       1       3       1       2       2       5       5       5       5
        3       4       3       9       2       1       1       2       2
1       0       2       3       2       1       1       1       5       1       1       1
        5       0       0       0       0       3       .       .       999
1       1       3       3       3       3       3       3       1       3       2       2
        2       2       2       2       1       2       2       1       2
0       3       1       1       1       1       5       1       4       0       0       6
        6       6       1       2       2       2       1       5       2
0       1       1       1       .       .       5       .       7       2       1       1
        1       9       0       1       1       1       1       1       1
3       1       1       1       1       1       1       3       7       1       1       5
        2       1       2       1       7       8       1       1       2
1       1       1       1       2       1       1       1       1       2       1       3
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       2       2       2       3       4
        1       4       .       33.75   11.19   41.89
23      109     63      165     65.2    26.8    23.9    420.00
3       2       223     3       1       1       1       1       1       1       1       1
        1       2       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       1       2
        1       1       0       0       0       2       1       1       1
1       3       3       1       2       1       5       1       1       1       1       1
        1       1       1       0       0       2       .       .       0
.       1       1       1       1       1       1       1       1       1       2       2
        2       2       2       2       1       1       1       2       1
5       1       2       1       1       1       1       1       1       1       0       5
        5       1       2       2       2       2       2       1       1
1       1       1       1       .       .       9       30      4       4       1       2
        3       9       0       3       2       1       1       9       1
8       1       1       1       1       9       1       1       1       7       2       7
        4       5       5       8       6       8       1       1       1
1       1       1       1       1       1       1       3       3       1       1       9       1
        1       3       1       1       1       1       10      1       1
1       1       1       1       1       9       0       2       2       1       2       2
        0       3       .       44.25   14.45   13.74
26      113     71      162     61.4    26.3    23.4    401.15
3       5       224     3       1       1       1       2       2       2       1       1
        1       1       1       1       1       1       1       3       1
1       1       1       1       2       1       1       1       2       2       2       2
        1       1       1       1       1       0       0       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       1       1       1       1500    8000    6       20      3       7       2       1
        8       1       0       2       1       1       1
1       4       5       1       1       1       1       1       1       1       5       3
        1       7       3       1       6       6       4       8       1
```

```
1       1       1       1       3       1       8       1       1       3       1       1
        1       2       1       4       1       3       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       1       20      41.5    13.88
19.53   26      135     83      169     72.7    31.8    25.5    455.23
3       5       225     3       2       2       5       4       4       3       2       1
        1       3       2       1       1       2       1       3       1
1       3       2       1       2       3       1       1       3       2       2       4
        1       1       1       1       0       1       0       .       2
1       2       1       2       2       1       1       5       5       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       3       3       3       3       1       3       1       1       1       0       1
        1       1       1       1       2       2       2       1       1
2       2       2       1       1500    7000    6       30      3       6       1       2
        1       1       0       1       1       1       1
1       2       5       1       1       1       3       1       5       1       3       5
        1       3       3       4       2       4       2       8       2
1       1       1       4       4       1       8       3       1       4       6       2
        1       2       3       1       1       2       1       1       1
1       1       1       1       1       1       1       1       0       1       2       3
        2       2       0       2       21      44      14.75   9.72
26      121     84      162     97.9    43      37.3    409.64
3       3       226     3       2       2       3       5       2       2       3       1
        1       5       2       1       3       2       1       1       1
1       2       2       2       3       1       1       2       2       1       1       3
        1       1       3       3       1       1       1       2       2
1       2       1       1       2       1       5       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       1
1       2       3       3       2       3       2       3       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       1       1       1       .       .       7       20      3       4       2       2
        3       1       0       1       1       1       1       1       2
8       1       2       1       8       1       8       1       7       8       1       5
        3       4       4       4       4       8       8       1       2
1       1       1       1       8       1       3       1       1       1       1       8
        8       8       1       1       1       1       1       1       8
1       1       1       1       1       1       0       3       3       2       3       2
        0       2       16      41      13.04   10.71   26
116     69      177     64.5    23.7    20.6    435.70
3       4       227     3       2       2       1       3       4       3       4       1
        1       3       3       3       1       4       1       1       3
4       4       2       2       4       2       2       4       2       3       3       4
        2       2       2       3       1       2       2       .       1
1       1       1       1       1       1       1       2       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       3       4       3       2       4       1       1       1       0       2
        1       1       1       3       3       1       2       1       1
3       2       2       2       1800    8000    8       30      1       5       1       2
        1       1       0       3       1       1       1
1       1       2       1       1       1       1       1       4       1       6       7
        2       8       4       1       6       9       4       8       1
```

```
1       3       1       1       1       1       2       1       1       3       1       1
        1       8       8       1       4       9       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       3       0       3       .       44.75   14.37
16.96   23      109     75      170     66      26.6    22.8    246.66
3       3       228     3       2       2       1       2       2       4       1       1
        1       2       1       1       1       2       4       3       2
1       4       2       1       2       1       1       2       3       1       2       3
        2       1       3       0       0       0       1       1       1
1       1       1       1       3       1       1       5       5       1       1       1
        1       1       1       1       0       1       3       1       4
3       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       1       1       1
0       1       2       2       5       1       2       2       4       5       7       5
        1       5       2       1       3       1       2       3       1
1       1       1       1       2100    .       6       .       4       2       1       2
        3       1       0       4       1       1       1       1
1       8       1       1       1       1       1       1       1       4       5       1
        1       2       1       1       1       5       8       6       1
1       1       1       1       2       1       3       1       8       8       1       1
        8       9       9       6       6       1       1       1       1
1       1       1       1       1       1       1       0       1       2       3       1
        4       1       3       .       41.75   12.4    0.84
25      108     70      171.5   76.5    35.2    26      434.77
3       3       229     4       2       1       2       2       2       1       2       1
        1       2       2       1       1       3       1       2       1
2       1       2       1       1       1       2       1       2       1       1       2
        1       1       2       3       0       1       1       0       2
1       1       1       4       1       1       1       1       1       1       1       1
        1       1       1       1       0       4       .       .       1
0       3       3       2       2       2       2       2       3       1       2       2
        2       2       2       2       1       1       1       1       2
0       1       3       2       3       2       1       1       2       0       0       2
        1       1       3       2       2       2       2       1       1
5       1       1       1       .       .       8       35      2       3       1       1
        6       1       0       1       1       1       1       1       5
1       1       1       3       2       1       8       6       6       8       1       7
        8       1       7       8       4       8       1       1       1
1       7       7       1       8       1       1       2       1       1       4       7
        2       1       5       5       5       1       1       6       1
1       1       1       7       1       1       0       2       2       2       2       1
        0       3       .       42.5    13.35   6.37
27      110     59      168     49.2    14      17.4    403.70
3       3       230     3       2       1       1       2       1       1       2       1
        1       2       2       2       2       2       1       1       1
1       1       3       2       2       1       1       2       2       1       1       1
        1       1       0       1       2       0       1       0       1
1       2       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       4       0
.       1       1       2       2       2       2       2       1       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       3       3       2       2       2       2       1       1       0       1
        1       1       1       2       2       2       2       1       1
5       1       1       1       2000    20000   7       60      3       3       1       1
        3       1       0       3       1       1       1
1       3       6       1       1       2       1       1       3       1       3       4
        1       8       1       1       6       8       3       8       3
```

```
1       3       1       8       1       1       8       1       1       3       1       1
        1       6       1       1       1       5       1       1       1
1       1       1       1       1       1       1       1       0       2       2       3
        3       2       0       3       4       42.75   13.77
6.11    31      112     62      178.5   61.9    24.1    19.4    425.94
3       5       231     4       1       2       3       2       3       1       2       1
        1       2       1       1       2       1       2       2       1
2       2       3       2       2       2       2       3       2       1       1       3
        2       2       1       0       0       1       1       0       2
1       2       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       3       3       3       2       1       1       1       1       0       1
        1       1       2       2       2       2       2       3       1
2       2       1       1       2500    10000   8       60      4       4       1       1
        4       1       0       1       1       1       1
1       3       8       1       1       1       1       1       1       1       3       2
        4       2       3       4       4       4       3       8       3
3       4       1       1       1       1       8       1       1       3       1       1
        1       3       3       1       4       4       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       9       40      13.31   27.49
30      114     56      163.5   56.6    20.1    21.2    443.26
3       4       232     4       2       2       5       1       2       2       1       1
        1       1       1       1       1       1       4       2       1
1       5       1       1       1       1       1       1       2       2       2       2
        1       1       0       0       1       1       1       2       1
1       1       2       1       3       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       2       1       1
        1       1       1       1       1       1       1       2       2
0       1       3       2       4       1       5       1       1       1       0       2
        1       1       2       1       1       2       3       1       3
5       1       1       1       2000    200     8       30      1       1       1       1
        8       8       0       4       1       1       1       1
3       3       8       8       1       1       1       3       1       1       1       5
        6       6       7       7       8       1       8       6       1
1       1       5       1       6       9       1       2       2       1       1       1
        6       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       3
        2       0       3       3       41.75   13.62   9.07
28      106     59      156.5   76      36.9    31      257.35
3       4       233     3       1       1       2       3       2       2       5       5
        1       3       3       3       1       5       1       4       3
2       3       2       2       4       4       1       2       1       1       2       4
        3       2       0       3       0       0       1       2       4
1       1       2       3       1       1       2       1       1       1       1       1
        1       1       1       1       1       0       1       1       1       2
3       1       1       3       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       1       1
0       1       1       1       3       1       2       4       3       1       0       2
        1       1       2       1       2       1       3       2       1
1       1       1       1       2400    10000   7       45      3       3       1       2
        2       1       0       1       1       1       1
1       1       1       1       1       1       1       1       1       1       2       2
        3       1       1       1       3       3       5       8       1
```

```
3       1       1       1       1       4       1       1       1       3       1       1
        1       1       3       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       3       2
        2       2       0       2       9       39      11.81   3.18
18      113     70      161     59.6    24.6    23      269.07
3       4       234     3       1       1       1       2       2       3       2       1
        1       2       1       1       1       2       1       1       1
2       2       2       1       2       1       1       2       2       1       3       3
        3       3       1       3       0       2       0       2       1
1       1       1       1       2       1       5       1       1       1       1       1
        1       1       2       1       0       2       .       .       3
4       2       1       2       2       2       2       2       2       2       1       2
        1       1       2       1       1       1       1       1       2
0       2       1       1       2       2       2       2       2       1       0       1
        1       1       1       2       3       2       2       3       4
4       4       4       4       1000    8000    6       45      1       1       1       1
        1       1       0       1       1       1       1
1       3       3       7       1       4       1       1       5       2       2       5
        3       5       5       6       6       7       4       8       1
1       1       1       1       1       6       8       1       2       5       1       1
        1       1       1       3       1       1       1       1       1
1       1       1       1       5       5       1       1       0       1       2       2
        1       1       0       3       6       42.75   13.97
1.46    27      106     68      169     82.8    34.9    29      452.09
3       5       235     3       1       1       2       2       1       1       1       1
        1       2       1       2       1       1       1       1       1
1       2       1       1       1       1       1       1       2       2       1       2
        3       1       0       0       1       1       1       1       1
1       1       1       1       5       1       2       1       1       1       1       1
        1       1       1       1       0       1       3       1       2
0       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       1       1       1       1       2       1       1       1       0       1
        1       1       1       2       3       2       2       1       1
1       1       1       5       .       .       .       60      1       4       3       1
        3       1       0       1       1       4       1       1       1
1       1       1       2       1       1       1       1       6       3       1       3
        1       4       3       2       1       8       1       1       3
1       1       1       1       1       1       1       3       8       1       1       6
        1       1       1       1       1       1       1       4       1
1       1       1       1       1       1       0       1       2       2       2       2
        0       1       5       35.5    11.07   8.78
27      107     58      167     104.9   42.7    38      310.24
3       4       236     3       3       2       4       5       2       1       1       1
        1       2       1       1       1       2       1       3       1
2       4       1       1       1       3       1       1       1       2       4       3
        1       1       3       0       1       3       1       2       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
4       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       2       2       2       2       2
0       2       4       4       3       2       2       1       1       1       0       2
        2       2       1       2       2       2       1       3       1
1       1       1       1       .       11000   5       0       4       4       3       2
        5       1       0       1       1       1       1       1
3       6       1       1       1       1       1       2       2       2       1       2
        4       2       2       3       2       4       8       4       2
```

```
3       1       1       1       1       2       1       1       4       8       1       1
        8       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       1       27      38.5    12.09   7.21
27      111     67      157     101     44.3    41      292.84
3       4       237     4       2       1       2       2       1       1       1       1
        1       2       1       1       1       2       1       2       1
1       2       1       1       1       1       1       1       2       2       2       2
        1       1       1       3       2       2       0       2       1
1       3       1       1       2       1       4       1       1       1       1       1
        1       1       2       5       2       2       .       .       0
.       3       3       2       2       2       2       2       2       1       1       2
        2       2       2       2       1       2       2       2       1
1       1       3       2       4       1       2       2       1       1       0       3
        1       1       2       2       2       2       2       1       1
5       5       5       5       1800    11000   7       50      1       8       1       1
        8       1       0       1       1       1       1
1       6       8       1       1       8       8       1       2       5       5       8
        1       8       8       6       6       8       2       8       1
1       1       1       6       1       4       5       1       1       1       1       2
        1       6       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       2       0       2       11      36      10.7    -0.03
23      98      64      169.8   61.1    22.7    21.2    297.76
3       4       238     3       1       1       2       2       1       1       2       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       3       1       1       1       1       1       3
        1       1       1       9       0       0       0       2       1
1       1       1       1       6       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       3       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       1       1       1       1       2       2       2       1       0       1
        1       1       2       3       3       3       3       3       1
1       1       1       1       .       20000   7       120     1       1       1       1
        2       1       0       1       1       1       1       1
1       1       1       1       1       1       1       1       1       1       2       1
        1       1       1       1       2       2       5       1       1
3       1       1       1       1       8       1       1       1       7       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       2       2       2       2
        2       0       2       23      43.75   13.4    5.19
18      104     69      165     55.2    18.3    20.3    452.85
3       3       239     3       1       2       3       4       1       2       3       1
        1       5       1       1       2       1       2       2       1
1       2       4       4       5       1       2       3       3       5       1       2
        1       1       3       1       1       1       1       1       1
1       1       1       1       3       1       1       1       5       1       1       1
        1       1       1       1       0       2       .       .       0
.       3       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
1       1       4       1       3       2       1       1       1       1       0       1
        1       1       1       2       2       2       2       2       1
2       1       1       1       2000    7000    6       45      4       4       1       4
        4       1       0       2       1       1       1
1       5       5       1       1       1       1       1       3       4       4       2
        2       4       3       3       4       7       3       8       1
```

```
1       2       1       1       1       1       8       1       3       5       1       1
        1       7       4       1       1       4       2       1       1
1       3       1       1       1       1       1       1       0       1       2       2
        1       4       2       3       1       38.5    11.89
3.55    42      115     74      156     54.1    24.1    22.2    340.37
3       6       240     3       1       2       1       3       3       3       1       1
        5       3       1       1       1       3       1       1       1
2       3       1       1       1       1       1       1       3       3       2       4
        2       2       2       1       2       2       1       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
3       2       2       2       2       2       2       2       2       2       1       2
        1       2       2       2       2       2       2       1       2
0       5       1       1       1       1       5       1       2       0       0       5
        2       1       1       2       3       3       2       5       5
1       2       1       1       .       .       6       .       1       1       1       1
        1       1       0       1       1       1       1       1       1
2       2       2       1       1       1       1       1       3       2       2       2
        1       1       1       1       1       8       1       1       1
1       3       2       1       2       1       1       1       1       1       1       2
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       2       2       2       2       2
        0       2       22      41      12.63   4.22    20
125     69      156     74      37.8    30.4    331.21
3       4       241     3       2       2       2       3       3       2       1       1
        1       2       2       2       1       1       1       2       2
2       1       1       1       1       1       1       1       1       2       1       2
        2       1       2       0       0       1       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       3       2       2       2       2       2       2       2       1       1
        2       1       2       1       1       1       1       1       1
9       3       1       1       1       1       1       1       1       1       0       1
        1       1       1       1       3       3       3       2       1
1       1       1       1       .       15000   6       30      1       2       1       1
        1       1       0       1       1       1       1       1
4       8       3       6       1       1       1       1       1       1       4       1
        1       1       8       8       2       2       8       2       4
1       7       1       1       1       7       1       1       1       2       1       1
        5       1       5       1       1       7       1       1       1
1       1       1       1       1       1       1       0       2       1       2       2
        2       0       2       1       41      12.84   4.07
23      159     101     165     114.9   48.4    42.2    292.58
4       4       242     4       1       2       1       2       1       2       1       1
        1       2       2       1       1       2       1       1       1
1       1       1       1       1       1       1       1       2       2       2       2
        1       1       0       0       0       0       0       0       2
1       1       1       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       3       1       4
2       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       1       1       1       1       2       2
0       1       2       1       2       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
3       2       1       4       2000    12000   7       30      1       1       1       1
        7       1       0       1       1       1       1
1       1       5       1       1       1       1       1       1       1       6       1
        1       6       2       1       6       8       1       8       1
```

```
1       6       1       1       1       1       7       1       3       2       1       1
        1       6       3       1       1       3       4       4       1
1       1       1       1       1       1       1       1       0       1       2       3
        1       1       0       3       33      38      11.71   8.03
27      107     55      161     58.4    19.9    22.5    346.49
4       3       243     2       1       1       2       2       2       1       1       1
        1       1       1       1       1       1       1       2       1
1       1       1       1       1       2       1       1       1       2       1       1
        1       1       1       0       0       1       0       0       3
1       1       2       1       1       1       2       1       1       1       1       1
        1       1       1       0       0       2       .       .       0
.       2       2       2       2       3       3       2       2       1       2       2
        2       2       2       2       3       2       2       1       2
0       1       2       3       1       2       2       1       5       0       0       1
        1       1       2       2       3       1       3       2       2
1       1       1       1       .       3000    7       .       2       3       1       2
        2       9       0       1       1       1       1       9
1       2       1       1       1       1       9       6       1       3       1       3
        3       1       1       1       2       2       8       1       2
6       1       1       1       1       6       1       1       2       3       1       9
        3       9       1       1       1       1       1       1       1
1       1       1       1       1       1       9       0       1       2       2       3
        2       0       2       4       43      13.56   18.23
27      121     73      170     117.3   51      40.6    358.88
4       4       244     3       2       1       3       2       2       1       2       1
        1       1       3       1       1       2       1       3       3
3       1       1       1       1       1       1       2       2       2       1       2
        2       1       3       0       1       1       0       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       2       2       1
10      1       1       1       1       1       3       1       1       1       0       1
        2       1       3       3       3       3       1       4       2
3       1       1       1       2000    7500    7       45      1       1       1       2
        4       9       0       1       1       2       1
1       1       5       1       1       1       2       1       2       1       3       2
        1       4       2       2       2       4       4       8       3
1       4       1       1       1       3       8       1       3       3       2       1
        1       4       1       5       2       2       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        1       1       0       3       302     44      13.89   5.70
18      102     50      165     62.2    26.6    22.8    383.33
4       4       245     4       1       2       2       2       1       1       2       1
        1       2       1       2       1       1       1       3       1
1       1       1       1       2       1       1       1       1       2       1       3
        1       1       0       0       0       0       0       1       1
1       1       1       1       2       1       5       1       1       1       1       1
        1       1       1       1       0       1       4       1       3
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       1       2       1       1       1       1       1       1       0       1
        1       1       1       2       2       2       2       4       4
3       2       2       5       1700    10000   6       30      1       2       1       1
        3       1       0       3       1       2       1
1       2       4       1       1       1       3       1       3       1       2       4
        2       4       4       2       5       6       2       8       2
```

```
1       1       1       6       1       2       7       1       2       2       1       2
        1       7       1       1       2       1       3       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       5       43      13.44   2.07
28      147     88      158     90.2    34.8    36.1    318.73
4       5       247     4       1       1       2       2       1       1       1       1
        1       1       1       1       1       1       1       1       1
2       2       1       1       1       1       1       1       1       2       2       1
        1       1       1       0       0       0       0       0       1
1       2       1       1       5       1       1       1       1       1       1       1
        1       1       1       5       11      2       .       .       3
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       2       2       2       2       2       2       2       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       1500    6000    8       90      4       2       1       4
        6       9       0       2       2       2       2
9       1       2       4       1       1       1       9       1       1       4       1
        6       4       4       1       4       4       4       8       6
1       1       1       1       1       2       3       1       1       3       5       5
        1       3       3       1       3       6       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       2       21      44      13.32   22.82
29      105     64      173     57.9    22.5    19.3    283.41
4       4       248     4       1       2       2       2       2       2       1       1
        1       1       1       1       1       1       1       1       1
1       2       1       2       1       1       1       1       2       1       1       2
        1       1       0       1       0       1       0       0       1
1       1       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       3       2       1       2       2       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
2       1       1       3       2000    .       7       30      2       5       1       2
        5       1       0       3       2       2       1       1
4       3       1       2       2       1       1       4       1       3       3       2
        5       1       3       3       8       2       8       3       1
2       2       1       1       6       3       2       2       4       1       1       1
        8       3       9       9       9       1       1       1       1
1       1       1       1       1       5       1       0       2       2       3       1
        2       0       3       15      41.25   12.42   9.47
23      108     58      175.5   62.2    21.1    20.2    383.41
4       4       249     3       1       2       3       3       3       2       2       1
        1       3       1       2       2       2       1       2       1
2       2       3       1       2       1       1       2       3       3       3       3
        3       1       2       0       3       1       2       1       1
1       1       1       1       2       1       1       1       1       1       1       1
        5       1       1       1       0       1       4       5       999
0       2       2       2       2       2       2       2       1       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       1       1       1       2       3       1       1       1       0       1
        1       1       2       2       2       1       2       2       1
2       1       1       1       .       10000   6       0       2       2       2       2
        3       9       0       1       1       1       1       1
2       5       1       1       1       1       1       4       1       3       3       1
        2       2       3       1       1       2       8       4       1
```

```
5       1       1       1       8       8       9       5       3       2       1       1
        4       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       3       .       43.25   13.25   21.93
43      101     59      161     57.5    22.8    22.2    311.43
4       4       250     4       1       1       1       2       1       1       2       2
        1       2       2       1       2       2       1       1       1
1       2       2       2       1       1       1       1       1       1       1       2
        3       1       2       0       1       1       0       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       1       1       1       4
2       2       3       2       2       2       2       2       2       2       1       2
        1       1       1       2       1       1       1       2       2
0       1       3       2       2       1       2       1       1       0       0       1
        1       1       2       2       2       2       2       3       3
3       1       1       2       .       .       6       60      1       1       1       1
        3       9       0       3       1       1       1       9       3
4       3       2       2       2       9       3       1       4       4       2       2
        2       2       2       3       2       8       4       2       5
1       3       1       2       3       1       1       1       2       1       1       3
        1       1       1       4       1       1       1       3       1
1       1       1       1       1       1       0       2       2       2       2       2
        0       2       23      40.25   11.76   7.00
21      107     73      173     73.3    30.8    24.5    340.80
4       3       251     3       2       1       2       2       1       2       3       1
        1       2       1       1       1       3       2       2       1
1       1       2       1       3       3       2       2       2       1       1       2
        1       1       1       2       1       0       0       2       1
1       1       1       1       1       1       5       1       1       1       1       1
        1       1       1       1       11      2       .       .       0
.       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       2       2       2       2       1       1       1       1       0       1
        1       1       2       2       2       1       2       3       1
1       1       1       1       .       .       7       0       4       3       2       1
        3       1       0       3       1       2       1       1       3
5       1       1       1       1       1       1       1       6       1       1       8
        1       1       3       8       3       8       1       3       1
8       3       8       8       3       1       1       1       3       1       1       1
        3       1       1       4       3       3       8       1       4
4       1       1       2       2       1       0       3       3       2       2       2
        0       2       14      40      12.6    7.21    46
106     59      165.5   63      28.3    23      338.85
4       4       252     3       1       1       1       2       2       2       1       1
        1       2       1       2       1       1       1       2       2
2       1       1       1       1       1       1       1       1       1       1       2
        1       1       0       1       1       1       1       1       1
1       3       2       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       1       4       7       2
4       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       2       2       2
0       1       3       3       1       3       3       1       1       1       0       1
        1       1       1       2       2       2       2       2       1
1       2       2       2       1900    11000   7       45      4       4       1       2
        2       1       0       1       1       1       1
1       2       4       1       1       5       4       1       4       3       3       3
        1       1       2       3       3       1       2       8       2
```

```
1       5       1       1       1       5       8       3       1       3       1       2
        1       5       1       1       1       1       5       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       4       1       3       .       46      13.91   13.37
23      104     58      163     65.8    32.1    24.8    419.92
4       4       253     3       1       1       3       4       2       1       2       1
        1       3       1       1       1       2       1       2       1
2       1       2       2       2       2       2       2       1       1       2       2
        3       1       1       0       2       0       1       1       1
1       1       1       1       1       1       1       5       1       1       1       1
        1       1       3       1       0       2       .       .       0
.       1       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       3       3       3       3       3       1       1       1       0       1
        1       1       2       3       3       3       1       1       2
2       2       2       5       1500    14000   7       30      3       4       1       2
        4       1       0       1       1       2       1
1       2       3       1       1       1       1       1       3       1       3       5
        2       4       2       5       5       5       3       8       1
1       8       1       1       1       1       8       6       1       3       1       6
        1       6       6       1       3       1       8       8       1
1       1       1       1       1       1       1       1       0       2       2       2
        1       4       1       4       .       38      11.54   62.21
32      113     56      159     60.3    22.7    23.9    249.29
4       4       254     3       1       1       1       2       2       1       1       1
        1       2       1       1       1       1       1       2       1
2       1       1       1       1       1       1       1       1       1       1       2
        1       1       2       1       0       1       1       0       1
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       3
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       2       1       1       2       2       1       1       1       0       1
        1       1       2       2       2       1       2       2       4
4       2       1       2       1600    .       7       45      1       2       1       1
        2       1       0       3       2       1       1       1
4       3       1       1       1       1       1       6       1       8       4       3
        1       4       5       4       4       2       8       1       1
1       1       1       1       1       5       1       1       7       1       1       1
        6       9       9       2       1       9       9       1       1
1       1       1       1       1       1       1       0       2       2       3       3
        2       0       2       18      45      14.28   7.48
27      129     73      172     63.6    29.8    21.5    448.35
4       3       255     2       4       4       2       2       4       4       5       4
        1       2       1       1       1       1       2       3       1
1       3       2       1       1       1       1       1       3       4       5       5
        2       3       1       0       0       2       0       0       2
1       2       3       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       1       1       2       1       3       1       1       1       0       1
        1       1       1       2       2       2       2       4       1
1       1       1       1       .       3000    7       0       3       5       1       4
        3       1       0       1       1       1       1       1
1       2       1       1       1       3       1       1       1       6       2       3
        5       2       4       3       1       3       8       5       1
```

8 1 1 1 1 1 1 1 6 2 1 1
2 9 9 9 9 9 1 1 1
3 1 1 1 1 1 1 0 1 2 2 2
2 0 3 209 44 13.75 7.75
18 107 64 162.5 65.6 26.6 24.8 319.15
4 4 256 3 1 2 2 1 3 2 1 3
1 2 2 1 1 1 1 2 1
1 2 2 1 2 2 2 2 2 1 2 2
2 1 0 1 1 1 0 0 2
1 2 2 1 1 1 1 1 1 1 1 1
1 1 1 5 2 2 . . 0
. 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 1 2 1 1 2
0 1 4 3 3 3 3 2 3 1 0 2
1 1 1 2 2 2 2 2 1
3 1 1 1 . . 7 . 3 4 4 5
3 1 0 1 1 1 1 1 1
4 1 1 1 1 1 1 1 7 1 1 1
3 3 3 1 1 8 1 1 8
1 1 1 1 2 1 1 1 6 1 1 6
1 1 1 1 1 1 1 1 3
1 3 1 1 1 1 0 1 1 3 1 2
0 2 1 46.5 13.65 10.29
22 121 74 175.5 101.3 43.9 32.9 393.34
4 4 257 3 1 1 2 1 1 2 1 1
1 1 1 1 1 1 1 1 2 1
1 1 1 1 1 1 1 1 2 2 1 2
1 1 0 1 1 0 0 0 1
1 1 2 1 1 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 1
4 2 2 2 2 2 2 2 2 1 2 2
2 2 2 2 1 2 2 2 2
0 1 2 2 2 2 1 1 1 2 7 1
1 1 2 2 2 2 2 1 1
1 1 1 2 2500 8000 8 45 1 1 3 4
3 1 0 1 2 2 1
1 1 3 1 1 1 1 1 1 1 1 2
1 3 2 2 3 2 2 8 1
1 5 1 1 1 3 8 1 1 1 1 1
1 4 1 1 3 1 3 1 1
1 1 1 1 1 8 1 1 0 1 2 2
2 2 0 2 26 46.5 14.3
20.90 37 112 76 162.5 61.8 22.8 23.4 247.42
4 4 259 4 1 2 2 1 1 1 1 1
1 2 1 1 1 3 1 1 1
1 1 1 1 1 1 1 1 3 1 2 3
1 1 0 0 0 0 0 0 1
1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 0 2 . . 0
. 1 1 1 1 1 1 1 1 1 2 2
2 2 2 2 1 1 1 2 2
0 2 3 3 1 1 1 1 1 1 0 1
1 1 2 2 2 2 2 5 2
2 1 1 1 1800 . 7 0 4 4 2 3
3 1 0 3 1 1 1 1
4 5 3 3 3 1 1 3 1 8 5 2
2 2 3 3 4 5 8 1 1

```
8       6       2       1       2       8       1       2       1       1       1       1
        4       3       1       1       2       1       2       1       1
1       1       1       1       1       1       1       0       2       2       2       2
        2       0       2       18      37      10.37   2.21
34      96      59      178.5   54.8    17.6    17.2    339.27
4       4       260     3       3       1       5       4       2       1       5       1
        1       2       1       1       1       1       1       3       3
1       2       4       1       2       5       1       1       2       3       3       4
        1       1       0       0       0       1       0       4       2
1       1       1       3       1       3       5       1       1       1       1       1
        1       1       1       5       2       1       4       1       0
.       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       2       2       1       2       1       1       1       1       0       2
        1       1       2       2       2       2       2       1       4
1       5       3       1       1200    .       7       60      1       6       1       1
        1       1       0       1       1       1       1       1
1       1       1       1       1       1       1       1       1       4       6       4
        1       1       1       1       1       1       8       3       2
3       1       1       1       1       6       1       1       1       2       1       9
        1       6       1       1       3       4       1       1       1
1       1       1       1       1       1       1       0       1       2       2       1
        1       0       2       10      46      13.73   3.58
19      132     78      160     59.4    25.8    23.2    356.50
4       5       261     3       1       2       1       1       1       1       2       1
        1       2       1       1       2       1       1       2       2
1       1       1       1       1       1       1       1       2       1       1       2
        1       1       0       0       1       1       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
0       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       1       2
0       1       1       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       5       2
3       2       1       1       .       .       7       .       1       7       1       2
        4       1       0       2       1       3       1       1       2
2       1       8       1       1       1       1       1       3       1       1       1
        2       1       2       8       3       8       4       1       2
1       1       1       5       1       1       1       1       3       5       1       3
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       0       3       2       3       3       2
        0       2       20      43      12.33   6.52    32
108     79      156.5   59.8    27.6    24.4    368.39
4       4       262     3       1       1       2       2       2       2       2       1
        1       1       2       1       1       1       1       1       1
1       1       1       1       1       1       1       1       1       2       2       2
        1       1       1       2       0       1       0       0       1
1       2       2       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       1       2
0       1       2       2       2       2       1       1       2       5       10      1
        1       1       1       2       2       2       2       1       1
1       1       1       2       .       15000   8       60      3       6       1       1
        3       9       0       1       1       2       1       9
1       6       1       1       7       1       9       5       2       6       5       3
        4       1       6       3       2       2       8       1       1
```

```
8       1       6       1       1       8       1       3       2       1       1       9
        6       3       2       1       9       9       9       10      1
6       1       1       1       1       1       9       0       1       2       2       3
        2       0       2       22      44      13.72   9.94
27      125     78      167     80.8    36.5    29      456.59
4       4       263     3       2       1       1       3       3       2       2       3
        1       2       2       1       1       3       1       1       1
2       2       2       2       3       2       2       2       2       1       1       2
        1       1       2       2       1       1       1       2       2
1       2       2       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       3       3       3       3       3       3       3       3       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       1       2       2       3       3       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
3       1       1       1       1900    12000   9       45      2       5       1       1
        1       1       0       2       2       2       1
1       4       8       1       1       8       2       1       1       1       1       4
        3       4       3       5       5       7       4       8       1
1       1       1       1       1       1       1       1       1       1       1       4
        1       4       1       8       1       8       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       3       .       45      13.92   7.12
22      95      52      164     50.3    15.6    18.7    384.43
4       5       264     3       2       2       2       2       1       2       1       2
        1       2       1       1       2       1       1       1       1
2       2       1       1       1       1       1       2       3       1       2       2
        1       2       0       0       1       1       0       0       2
1       1       2       2       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       1       1       1       1       1       1       0       1
        1       1       1       2       2       2       1       2       3
3       2       1       2       1500    .       8       .       3       2       1       3
        4       1       0       1       1       2       1       1
3       5       2       1       1       1       1       4       1       1       4       2
        4       3       1       1       3       5       8       1       1
1       5       1       1       1       1       1       1       1       1       1       1
        3       1       1       1       1       1       1       1       3
1       1       1       1       1       1       1       0       3       2       2       2
        2       0       2       24      40.25   12.54   16.75
24      98      51      150.5   45.2    11.9    19.8    283.58
4       4       265     3       1       1       2       2       2       1       2       1
        1       2       1       1       1       2       1       1       1
1       1       1       1       1       1       1       1       1       1       1       2
        1       1       1       0       1       1       0       1       2
1       1       1       1       2       1       1       5       1       1       1       1
        1       1       1       5       1       1       4       1       4
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       2       2       1
2       1       2       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       1       2       1       1
1       4       4       3       1530    2000    7       0       2       3       2       1
        3       1       0       1       1       2       1
1       2       1       1       1       1       1       1       3       1       6       5
        2       3       2       4       4       2       3       8       1
```

```
1       5       1       1       1       1       8       2       4       2       2       8
        1       8       1       1       1       1       1       1       1
8       1       1       1       1       8       8       1       0       2       2       2
        2       4       3       2       30      44.75   13.92
112.76          51      131     83      173     81.8    36.6    27.3    337.23
4       5       266     3       2       2       3       2       3       3       2       4
        1       2       4       1       1       2       1       3       1
2       3       2       1       2       1       1       2       2       3       3       3
        3       3       3       1       0       0       1       0       2
1       2       2       2       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       1       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       2       3       2       3       4       3       1       1       1       0       1
        1       1       1       2       2       2       2       1       1
2       2       1       2       1500    1000    7       75      4       5       2       3
        7       1       0       3       1       2       1
1       4       7       1       1       4       4       1       7       5       5       6
        4       5       2       6       5       3       3       8       2
1       8       1       1       1       3       8       1       2       2       1       7
        1       8       3       1       1       1       3       3       1
1       6       1       1       1       5       5       1       0       1       2       2
        1       2       0       1       5       43.5    13.77
15.30   21      121     79      162     66.4    26.7    25.3    358.76
4       4       267     4       1       1       2       2       1       2       2       1
        1       2       1       1       1       1       1       1       1
1       2       1       1       1       2       1       1       1       1       1       3
        2       1       0       2       0       0       0       0       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       2       2       2       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       3       2
1       1       1       3       2500    1000    7       45      6       5       1       1
        5       1       0       4       1       1       1
1       5       5       1       1       1       3       1       4       1       4       8
        5       5       3       6       6       3       5       8       5
5       3       1       1       1       8       6       4       1       4       3       1
        1       7       7       6       1       1       1       6       1
1       5       1       1       1       1       1       1       0       1       2       1
        1       2       0       2       5       41      13.25   6.46
18      100     67      165     54.6    18.6    20.1    433.53
4       4       268     4       2       1       1       3       2       1       1       2
        1       2       1       2       1       1       1       2       1
1       1       2       2       2       2       2       2       2       1       2       2
        2       2       2       1       1       1       0       0       2
1       1       1       2       2       1       1       1       1       1       1       1
        1       1       1       1       2       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       3       3       3       3       3       1       1       1       0       1
        1       1       1       2       2       2       2       2       2
2       2       2       2       1600    8000    7       45      1       2       1       2
        4       1       0       1       1       1       1
1       3       3       1       1       1       2       1       4       1       4       2
        3       3       3       1       3       1       3       8       1
```

```
1       1       1       1       1       3       7       1       2       2       2       2
        1       5       5       1       1       1       1       1       1
1       5       1       1       1       1       1       1       0       1       2       1
        1       2       0       2       5       46.5    13.54
23.35   22      99      72      165.5   57.3    20.5    20.8    476.56
4       5       269     3       1       1       1       2       1       1       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       3       1       1       1       1       1       2
        1       1       0       0       0       1       0       1       1
1       1       2       1       1       1       2       1       1       1       1       1
        1       1       3       1       0       2       .       .       4
2       2       2       2       2       2       2       2       2       2       1       2
        1       2       1       2       1       2       1       2       1
5       1       1       2       2       4       1       1       1       1       0       1
        5       1       1       1       1       1       1       1       1
5       1       2       1       2400    6000    8       30      1       1       1       1
        8       8       0       2       1       2       1
1       8       8       3       1       2       1       9       1       1       1       5
        1       8       6       5       5       8       3       8       1
1       1       1       1       5       1       8       1       4       5       1       1
        1       1       1       9       3       9       1       1       6
1       1       5       1       8       5       8       6       2       1       2       2
        3       2       0       2       15      43      13.12   4.36
48      97      64      185.5   63.5    23.9    18.5    272.04
4       4       270     3       2       2       2       2       2       1       2       1
        1       3       2       1       1       1       3       1       1
1       2       2       1       2       1       1       2       2       2       1       3
        1       1       1       0       0       3       0       2       1
1       1       1       1       2       1       2       1       1       5       1       1
        5       1       1       1       0       1       4       1       3
4       2       2       2       2       2       2       2       1       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       1       2       3       2       1       1       1       0       1
        1       1       2       1       3       1       3       3       1
3       2       2       2       1700    10000   8       0       2       2       1       2
        4       1       0       2       1       2       1
1       3       6       1       1       2       2       1       4       1       3       4
        4       4       3       4       2       4       2       5       5
1       3       1       3       1       3       8       1       5       2       3       2
        1       2       1       1       3       1       1       1       1
1       1       1       2       4       1       1       1       0       1       2       2
        2       2       0       2       18      38      11.69   3.64
45      111     66      173     83.2    39.6    27.8    337.61
4       5       271     3       1       1       1       1       1       1       1       1
        1       2       1       1       1       2       5       5       1
1       2       5       5       3       2       2       1       1       1       1       1
        1       1       1       1       3       2       1       .       1
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       1       1       1       4
3       1       1       2       2       1       1       2       2       3       1       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       2       1       2       3       1       1       0       1
        1       1       2       1       1       1       1       2       2
2       1       2       2       2000    15000   5       60      4       4       4       4
        4       9       0       1       1       1       1
1       4       4       1       1       1       4       1       5       3       5       4
        4       4       4       4       4       4       1       8       1
```

```
1       1       1       1       1       1       8       5       1       1       1       1
        1       6       6       1       1       1       1       1       1
1       1       1       1       1       1       8       1       0       1       2       2
        2       2       0       2       1       38.5    11.52
5.74    53      143     73      155     61.5    24.9    25.6    306.16
4       4       272     4       1       1       1       2       1       1       1       1
        1       3       1       1       1       1       1       1       1
1       3       2       1       1       1       1       1       2       1       1       3
        1       1       1       1       3       1       1       1       1
1       2       1       1       2       1       5       2       1       1       1       1
        1       1       2       1       0       2       .       .       0
.       2       2       2       2       1       1       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
1       1       1       1       2       3       1       1       1       1       0       1
        1       1       2       1       1       1       2       2       1
3       2       2       5       1800    7000    6       20      6       3       1       2
        5       1       0       3       1       1       1
1       3       4       1       1       1       3       1       6       2       6       4
        1       3       1       3       4       3       3       8       1
3       1       1       4       4       3       8       3       3       3       2       1
        1       6       5       3       1       1       2       1       1
1       6       1       3       1       5       1       1       0       2       2       2
        1       2       0       3       22      42.25   14.3
12.33   41      136     82      156.5   60.2    28.3    24.6    452.15
4       3       273     3       1       2       1       5       3       3       1       1
        1       3       1       1       1       2       1       2       1
1       1       2       2       1       1       1       1       2       2       3       3
        1       2       1       0       0       1       0       1       1
1       2       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       2       4       3       2       1       4       1       1       1       0       1
        1       1       2       2       1       1       2       1       1
5       1       1       2       2000    5000    6       10      2       3       1       3
        5       1       0       1       1       1       1
1       3       3       1       1       3       1       1       2       1       5       3
        3       5       4       8       8       7       2       8       1
1       2       3       1       7       5       8       1       1       2       1       1
        1       4       3       1       1       1       1       1       1
1       6       1       1       3       1       3       1       0       1       2       2
        2       3       0       2       .       42      13.25   49.29
43      99      71      163     66.2    30.1    24.9    303.27
4       4       274     2       2       2       3       3       2       2       2       1
        1       2       2       1       1       1       1       2       1
2       3       1       1       2       1       1       1       1       2       2       2
        1       2       0       0       0       1       0       0       1
1       2       2       1       2       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
2       2       3       2       2       2       2       2       2       1       2       2
        1       1       1       2       3       2       2       1       1
4       2       2       3       1       2       2       1       2       1       0       1
        1       2       2       3       3       3       3       2       2
2       1       1       1       .       .       5       .       1       7       2       3
        8       9       0       4       1       2       1       9       2
1       4       3       1       1       9       3       1       1       2       3       1
        4       2       3       3       3       8       2       1       4
```

```
3       1       1       1       3       1       1       1       1       1       9       6
        3       1       9       9       9       9       10      1       1
1       3       1       1       2       9       0       1       3       2       2       2
        0       2       20      38      11.42   1.83    19
99      63      156.5   47.2    11.1    19.3    331.90
4       3       275     3       1       1       1       2       1       1       1       1
        1       2       1       1       1       1       1       2       1
1       1       1       1       1       1       1       1       1       1       1       2
        1       1       0       1       0       1       0       0       2
1       1       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
0       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       1       1       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       2       1
3       1       1       1       2000    10000   7       20      4       5       1       1
        3       1       0       1       1       1       1
1       4       4       1       1       1       1       1       6       5       5       4
        4       4       1       1       2       3       7       8       4
1       5       1       1       1       1       9       1       1       2       2       1
        1       7       7       1       2       2       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       2       0       3       18      39      14.6    27.12
31      118     64      164     80.7    35.1    30      449.11
4       3       276     2       1       1       3       2       4       4       2       2
        1       3       2       1       2       2       1       2       1
2       1       1       1       3       1       2       1       2       2       1       4
        1       2       4       0       0       0       0       0       2
1       4       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       3       1       1       1       1       1       0       1
        1       1       2       2       1       1       2       1       2
2       3       2       2       2100    .       7       0       4       5       1       2
        4       1       0       3       1       2       1       1
2       3       4       1       1       1       1       4       1       4       3       2
        3       3       4       3       4       3       8       2       1
4       2       2       1       5       8       1       3       2       1       3       1
        6       4       1       1       3       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       1
        2       0       2       20      44.5    12.85   31.11
29      122     81      167     82.1    32.8    29.4    399.11
4       4       277     4       1       1       2       1       1       1       1       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       3       2       1       1       1
        1       1       0       0       0       1       0       0       1
1       1       2       1       1       1       5       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
4       3       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       1       2       1       1       1       1       1       0       5
        1       1       1       2       2       2       1       1       1
5       3       3       5       1300    6000    8       30      2       4       5       5
        8       2       2       1       1       3       1
1       5       4       1       1       1       2       1       3       3       4       6
        2       8       7       6       7       8       3       8       1
```

```
1       1       1       1       1       1       1       1       1       1       1       4
        1       6       1       1       2       3       1       1       1
8       1       5       8       1       5       1       1       0       1       2       2
        2       2       0       2       31      41.75   13.61
27.48   34      112     54      165.5   86.1    41.2    31.4    271.44
4       2       278     3       2       2       3       2       2       2       1       1
        1       1       2       1       1       1       3       1       1
3       3       1       1       1       1       1       1       3       1       3       3
        2       1       2       1       0       3       0       1       1
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       5       12      2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       1       2       1       1       1       1       1       1       0       1
        1       1       2       2       2       2       2       1       1
1       1       1       1       2000    10000   6       60      2       5       1       1
        8       1       0       2       1       1       1
1       2       2       1       1       1       1       1       2       1       4       1
        1       1       2       1       1       1       5       8       1
1       1       1       1       1       4       3       1       1       4       1       1
        1       4       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       2       41.5    12.95
7.91    22      142     88      167     79.6    33.5    28.5    302.15
4       3       279     4       2       1       3       2       2       1       2       1
        1       2       1       2       1       1       1       1       1
1       2       2       1       2       2       1       1       2       1       1       2
        2       1       1       2       1       1       0       1       1
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       1       0       3       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       1
7       3       2       2       2       2       3       1       1       1       0       1
        1       1       2       1       3       3       1       1       2
3       2       1       1       2000    15000   7       100     2       5       1       2
        8       1       0       3       1       1       1
1       2       5       1       1       3       1       1       5       2       6       3
        3       6       3       4       5       7       3       8       3
3       2       1       1       1       1       1       1       1       2       1       1
        1       6       2       1       1       3       1       2       1
1       1       1       1       5       1       1       1       0       1       2       2
        2       2       0       2       13      39.5    12.77
8.49    22      115     64      171     68.2    26.9    23.3    394.51
4       5       280     2       2       2       3       2       2       2       1       2
        1       2       1       1       1       1       2       3       2
3       3       1       1       1       1       1       2       2       3       2       3
        2       3       0       2       1       1       1       2       2
1       1       2       2       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       1       2
0       1       2       2       2       1       2       1       2       1       0       1
        1       1       2       2       2       2       2       5       1
1       1       1       1       3000    15000   7       30      2       4       1       1
        3       1       0       1       1       1       1
1       1       1       1       1       1       1       1       1       1       3       1
        1       2       1       2       2       2       2       8       2
```

```
2       1       1       1       1       1       3       1       2       3       5       1
        1       1       1       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       3       2       3
        3       1       0       2       66      41.25   12.95
7.84    21      137     82      172.5   136.9   52.4    46      313.73
4       6       281     2       2       2       4       3       3       2       1       2
        1       3       2       2       2       4       1       5       5
5       4       1       1       2       1       2       2       2       2       2       2
        2       2       0       0       0       3       1       0       2
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       3       1       2       .       .       2
4       1       1       1       2       2       2       2       2       1       2       2
        2       2       2       2       2       2       2       2       2
0       1       2       1       2       1       3       3       1       1       0       1
        1       1       1       2       2       2       2       5       1
1       1       5       5       1500    2000    5       30      3       5       1       1
        3       1       0       8       1       1       1
1       1       1       1       1       8       1       1       1       1       1       1
        1       6       6       5       1       1       1       8       8
1       1       1       1       1       1       1       1       1       1       1       1
        1       3       1       8       8       1       3       1       1
1       8       8       8       1       1       1       1       0       1       2       2
        2       2       0       1       18      41.5    13.46
8.26    29      120     85      165.5   121.2   50.2    47.9    409.35
4       5       282     4       0       1       2       3       1       1       1       1
        1       2       2       1       2       2       2       1       1
2       2       1       1       1       1       1       1       1       1       1       1
        2       1       1       0       1       1       0       0       1
1       1       1       2       3       1       1       1       1       1       1       1
        1       1       1       1       0       4       .       .       1
0       1       1       1       1       1       1       1       1       2       2       2
        2       2       2       1       1       1       1       1       1
11      1       2       1       3       1       2       1       1       0       0       1
        1       2       2       1       1       1       1       2       2
2       1       1       1       .       .       6       1       1       1       1       1
        6       9       0       2       1       1       1       1       1
1       1       7       1       1       9       1       1       1       2       1       5
        7       3       7       8       1       8       1       1       4
3       4       1       5       8       1       1       1       1       1       9       4
        3       5       4       5       1       1       10      5       5
5       5       5       5       1       9       0       2       2       2       2       2
        0       2       13      35      11.62   8.40    41
116     68      159     84.6    43.9    33.5    380.64
4       5       283     3       1       1       1       1       1       1       1       1
        1       2       1       1       1       1       1       2       1
1       1       1       1       1       1       1       1       2       2       2       3
        1       1       0       1       0       0       0       0       1
1       1       1       3       1       1       1       1       1       1       1       5
        1       1       1       1       0       1       4       5       0
.       2       1       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       2
0       1       1       2       1       1       3       1       1       1       0       1
        1       1       1       2       2       2       2       1       1
1       2       2       2       1650    .       8       45      4       6       2       1
        4       1       0       1       1       2       1       1
3       1       1       1       1       1       1       4       1       4       1       1
        1       1       1       1       1       4       8       1       1
```

```
2       1       1       1       2       3       1       1       1       1       8       1
        3       4       1       1       1       1       1       1       1
2       1       1       1       2       1       1       0       2       2       2       2
        2       0       1       21      41.25   12.15   9.76
32      114     79      165.5   81.1    38.9    29.6    331.31
4       5       284     3       1       2       1       2       2       1       1       1
        1       3       1       1       1       1       1       1       1
2       2       2       1       1       1       1       2       1       2       1       3
        1       1       1       1       1       0       0       0       1
1       1       1       1       5       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       1
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       1       1       2       2
0       1       2       2       1       2       2       1       1       1       0       1
        1       1       2       2       2       2       2       2       2
4       1       1       3       .       .       6       30      3       1       2       2
        3       1       0       2       1       1       1       1       4
3       1       1       1       1       1       5       1       3       3       1       4
        1       1       4       3       2       8       8       1       4
1       1       1       1       5       1       1       1       4       1       1       3
        1       1       2       1       1       1       1       1       1
1       1       1       1       1       1       0       2       2       2       2       2
        0       2       15      41.5    12.35   30.19
26      105     63      165     54.1    14.7    19.9    345.33
4       4       285     3       2       1       2       2       2       2       3       2
        1       2       1       1       1       1       1       2       1
1       1       1       1       1       1       2       1       1       1       2       2
        2       1       1       2       1       1       0       1       2
1       1       1       1       1       1       2       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       1       1       2       1       2       1       1       1       0       1
        1       1       1       2       2       2       2       2       2
2       1       1       1       2500    2500    7       30      1       2       1       1
        4       9       0       1       1       1       1
1       4       4       4       1       1       1       1       5       4       5       3
        3       5       4       4       4       4       2       8       4
4       4       1       1       5       5       2       1       1       1       1       1
        1       3       3       1       1       1       1       1       1
1       1       1       1       1       1       1       1       0       2       2       2
        2       1       0       2       .       40      13.03   77.47
21      143     93      157.5   99.1    42.2    39.9    353.64
4       4       286     2       1       1       1       2       2       2       1       1
        1       1       1       2       1       1       1       1       1
1       1       1       1       1       1       1       1       2       2       1       2
        2       1       1       1       0       0       0       0       2
1       1       1       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       2
4       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       2
0       1       1       1       1       1       1       1       1       1       0       1
        1       1       1       2       2       2       2       1       1
1       1       1       1       .       .       7       30      2       7       1       2
        7       1       0       1       1       1       1       1       6
6       1       1       1       1       1       3       1       7       5       5       5
        5       1       3       5       3       8       8       1       8
```

```
1       1       1       1       1       1       1       1       1       1       1       9
        9       9       9       9       9       9       9       1       1
1       1       1       1       1       1       0       1       2       2       2       1
        0       2       .       38.5    12.36   21.83
26      114     79      164     100.3   44.5    37.3    332.35
4       4       287     3       1       2       2       2       1       1       2       1
        1       2       2       1       1       1       2       3       2
2       2       1       3       2       1       1       1       2       2       2       2
        2       2       1       1       0       2       1       1       2
1       5       1       1       3       1       1       1       5       1       1       1
        5       1       1       5       1       1       4       1       0
.       1       1       2       2       2       2       2       1       1       2       2
        2       2       2       2       1       2       1       2       1
5       1       1       2       1       1       5       1       1       1       0       1
        5       3       2       2       2       1       2       1       1
3       1       1       1       .       10000   8       20      2       4       1       2
        8       9       0       2       1       1       1       1
2       4       1       1       5       1       1       4       1       3       4       3
        8       3       1       6       5       2       8       1       1
6       1       1       1       4       8       1       5       3       1       1       1
        4       3       4       3       2       1       1       1       8
8       8       1       1       1       8       1       0       1       2       2       2
        2       0       2       5       38.75   12.55   10.83
44      114     69      173     60.7    24      20.3    308.16
4       4       288     3       1       1       2       3       1       1       1       1
        1       3       1       1       1       2       1       3       1
1       3       1       1       1       2       1       2       2       1       2       2
        1       1       1       1       1       1       0       0       1
1       1       2       1       1       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       3       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       1       2       1
5       1       2       2       2       1       1       1       1       1       0       2
        2       1       2       1       1       1       3       1       2
1       1       1       1       2000    7000    5       10      3       3       1       3
        2       1       0       1       1       1       1
1       1       3       1       1       1       2       1       1       1       2       3
        1       4       2       1       1       2       2       8       1
1       1       2       1       1       8       1       1       1       3       1       1
        1       1       1       1       2       4       1       1       1
1       1       1       1       1       1       1       1       0       1       2       2
        2       2       0       2       7       36      11.08   6.76
24      106     61      162     65.7    29.2    25      338.58
4       4       289     3       2       2       3       3       1       2       2       1
        1       4       1       1       1       1       1       2       2
1       1       1       1       1       2       1       2       2       1       1       2
        3       3       1       0       1       2       1       1       1
1       2       1       1       2       1       1       1       1       1       1       1
        1       1       1       1       0       2       .       .       0
.       2       2       2       2       2       2       2       2       1       2       2
        2       2       2       2       1       2       2       2       1
12      1       3       1       3       1       1       1       1       1       0       1
        1       1       2       2       2       2       1       1       2
3       2       1       1       1500    .       8       0       2       4       1       2
        8       1       0       1       1       1       1       1
3       1       1       1       1       3       1       4       2       3       2       2
        3       4       1       5       3       3       8       1       1
```

```
5       1       1       1       4       8       1       1       4       1       9       1
        5       5       1       4       1       1       1       1       1
1       1       1       1       1       1       1       0       1       2       2       2
        2       0       2       12      44      14.52   31.97
53      132     75      169.5   81.9    38.9    28.5    342.36


;

proc sort data = all_data; by q100;
proc format;
        value sco_1fmt
        1 = 'Type_1'
        2 = 'Type_2'
        3 = 'Type_3'
        4 = 'Type_4'
        5 = 'Type_5'
        6 = 'Type_6';
        value v8fmt
        1 = '8_28_15'
        2 = '8_31_15'
        3 = '9_5_15'
        4 = '9_6_15';
        value q2fmt
        1 = 'poor'
        2 = 'fair'
        3 = 'good'
        4 = 'excellent';
        value q4fmt
        0 = 'Not_at_all'
        1 = 'Occasionally/Several_days'
        2 = 'More_than_half_the_days'
        3 = 'Nearly_every_day';
        value q9fmt
        0 = 'none_are_applicable'
        1 = '1_condition'
        2 = '2_conditions'
        3 = '3_conditions'
        4 = '4_conditions'
        5 = '5_conditions'
        6 = '6_conditions'
        7 = '7_conditions'
        8 = '8_conditions'
        9 = 'choose_not_to_answer';
        value Fe_Def_symptom_sumfmt
        1='low number of deficiency symptoms'
        2='high number of symptoms';
        value q15_TEXTfmt
        0 = 'none'
        1 = 'digestion_problems'
        2 = 'hypothyroidism'
        3 = 'raynauds_syndrome'
        4 = 'incontinence'
        5 = 'kidney_stones'
        6 = 'blood_clots'
        7 = 'cancer'
        8 = 'sleep_deprivation';
        value q17fmt
```

```
1 = 'daily'
2 = '4_to_6_times_a_week'
3 = '2_to_3_times_a_week'
4 = 'once_a_week'
5 = 'Less_than_once_a_week'
6 = 'choose_not_to_answer';
value q18_11_TEXTfmt
0 = 'none'
1 = 'iron_supplement'
2 = 'birth_control'
3 = 'digestion'
4 = 'migraines'
5 = 'pain'
6 = 'urinary_incontinence'
7 = 'cardiovascular_health'
8 = 'antibiotic'
9 = 'Blood_clots'
10 = 'asthma'
11 = 'acne'
12 = 'glaucoma';
value q20fmt
1 = 'yes'
2 = 'no'
3 = 'do_not_know'
4 = 'choose_not_to_answer';
value q21fmt
0 = 'choose_not_to_answer'
1 = '0_to_2_months'
2 = '3_to_5_months'
3 = '6_to_11_months'
4 = '12_months_or_more';
value q22fmt
1 = 'low_iron'
2 = 'elevated_heart_rate'
3 = 'hepatitis_b'
4 = 'travel'
5 = 'unknown'
6 = 'tattoo';
value q23fmt
0 = 'never'
1 = 'one_two_times'
2 = 'three_to_five_times'
3 = 'six_to_ten_times'
4 = 'greater_than_ten_times'
999 = 'choose_not_to_answer';
value q27fmt
1 = 'yes'
2 = 'no'
3 = 'choose_not_to_answer';
value q27_TEXTfmt
0 = 'none'
1 = 'fruit'
2 = 'nuts_seeds'
3 = 'eggs_and_dairy'
4 = 'shellfish_or_seafood'
5 = 'gluten'
6 = 'citrus_and_dairy'
7 = 'vegetables'
```

```
8 = 'Dairy'
9 = 'legumes'
10 = 'spices'
11 = 'pork'
12 = 'vegetables_and_nuts';
value q28_9_TEXTfmt
0 = 'none'
1 = 'fruit'
2 = 'greasy_or_dry_foods'
3 = 'Chinese_cuisine'
4 = 'eggs'
5 = 'salty_foods'
6 = 'vegetables'
7 = 'dairy'
8 = 'meat'
9 = 'meat_and_fish'
10 = 'textures';
value q37fmt
1 = '0_days'
2 = '1_days'
3 = '2_days'
4 = '3_days'
5 = '4_days'
6 = '5_days'
7 = '6_days'
8 = '7_days';
value q44_8_TEXTfmt
0 = 'none'
1 = 'b_vitamins'
2 = 'probiotic'
3 = 'flax_oil'
4 = 'magnesium'
5 = 'fiber'
6 = 'multi_without_iron';
value q47fmt
1 = 'once_every_2_to_3_months'
2 = 'monthly'
3 = 'more_than_monthly'
4 = 'other'
5 = 'choose not to answer';
value q47_TEXTfmt
0 = 'not_applicable'
1 = 'Never_in_the_last_6_months'
2 = 'once_every_3_months'
3 = 'once_every_6_months';
value q48fmt
1 = 'heavy'
2 = 'normal'
3 = 'light'
4 = 'choose_not_to_answer';
value dep_severityfmt
1='none'
2='mild'
3='moderate'
4='moderately severe'
5='severe';
value ferritin_statusfmt
1='iron deficient'
```

```
2='mild iron deficiency'
3='normal iron status';
value dep_cutofffmt
1='no or little depression'
2='moderate to severe depression';
value ferritin_cutofffmt
1='iron deficient'
2='normal iron status';
value iron_statusfmt
1='anemic'
2='normal iron status';
value fatiguefmt
1='not often tired'
2='often tired';
value function_deffmt
1='function iron deficiency'
2='no functional iron deficiency';
value meat_statusfmt
1='omnivore'
2='no red meat'
3='vegetarian';
value meat_consumptionfmt
1='no meat'
2='meat 1 or 2 days'
3='meat 3 or more days';
value learning_statusfmt
1='normal'
2='1 or more learning issues';
value emotion_statusfmt
1='normal'
2='1 or more emotional issues';
value func_iron_def_symp_cutofffmt
1='little or no funtional iron deficiency symptoms'
2='functonal iron deficiency symptoms present';
value select_iron_def_symp_cutofffmt
1='little or no select iron deficiency symptoms'
2='select iron deficiency symptoms present';
value anemia_select_Fe_def_sym_cutofffmt
1='no select Fe def, no anemia'
2='no select Fe def, with anemia'
3='select Fe def, no anemia'
4='select Fe def, with anemia';
value anemia_dizzy_SOB_cutofffmt
1='no dizzy/SOB, no anemia'
2='no dizzy/SOB, with anemia'
3='dizzy/SOB, no anemia'
4='dizzy/SOB, with anemia';
value PBF_statusfmt
1='fit'
2='average'
3='obese';
value BMI_statusfmt
1='underweight'
2='normal weight'
3='overweight'
4='obese';
value BMI_cutofffmt
1='under to normal'
```

```
2='overweight to obese';
value BP_statusfmt
1='normal'
2='perhypertension'
3='hypertension';
value TIBC_cutofffmt
1='normal'
2='iron deficient';
value ID_no_anemiafmt
1='ID without anemia'
2='normal iron status';
value ID_and_anemiafmt
1='ID and anemic'
2='not ID or anemic';
value IDfmt
1='Iron deficient by both ferritin and TIBC'
2='not iron deficient by both ferritin and TIBC';
value TIBC_ferritin_fatiguefmt
1='ID and fatigued'
2='ID but not fatigued'
3='no ID and no fatigue';
value racing_thoughtsfmt
1='no racing thoughts'
2='racing thoughts';
value dizzinessfmt
1='no dizziness'
2='dizziness';
value fatigue_with_sleepfmt
1='fatigue does not increase with sleep'
2='fatigue increases with sleep';
value headachesfmt
1='no headaches'
2='headaches';
value short_breathfmt
1='no shortness of breath'
2='shortness of breath present';
value thyroidfmt
1='thyroid problem'
2='no thyroid problem';
value AA_cutofffmt
1='little or no ascorbic acid consumption'
2='excessive ascorbic acid consumption';
value MF_cutofffmt
1='little or no meat factor consumption'
2='excessive meat factor consumption';
value OA_cutofffmt
1='little or no other alcohol consumption'
2='excessive other alcohol consumption';
value polyphenol_cutofffmt
1='little or no polyphenol consumption'
2='excessive polyphenol consumption';
value calcium_cutofffmt
1='little or no calcium consumption'
2='excessive calcium consumption';
value soy_cutofffmt
1='little or no soy consumption'
2='excessive soy consumption';
value egg_cutofffmt
```

```
1='little or no egg consumption'
2='excessive egg consumption';
value phytate_cutofffmt
1='little or no phytate consumption'
2='excessive phytate consumption';
value coffee_cutofffmt
1='little or no coffee consumption'
2='excessive coffee consumption';
value tea_cutofffmt
1='little or no tea consumption'
2='excessive tea consumption';
value redwine_cutofffmt
1='little or no red wine consumption'
2='excessive red wine consumption';
value skinfmt
1='skin symptoms present'
2='limited skin symptoms present';
value nailsfmt
1='nails symptoms present'
2='limited nails symptoms present';
value hairfmt
1='hair symptoms present'
2='limited hair symptoms present';
value eyesfmt
1='eye symptoms present'
2='limited eye symptoms present';
value temperaturefmt
1='temerpature control symptoms present'
2='limited temperature control symptoms present';
value miscfmt
1='misc symptoms present'
2='limited misc symptoms present';
value physical_cutofffmt
1='appreciable physical sypmtoms present'
2='limited physical symptoms present';
value refused_bloodfmt
1='blood could not be donated because of iron status'
2='never been turned away from donating blood';
value donationfmt
1='never donated blood'
2='donated blood 1-5 times'
3='donated blood 6 or more times';
value cravings_cutofffmt
1='significant craving symptoms'
2='no significant craving symptoms';
value intolerances_cutofffmt
1='significant intolerances'
2='no significant intolerances';
value Q28_cutofffmt
1='significant cravings and intolerances'
2='no significant cravings and intolerances';
value short_memoryfmt
1='short term memory symptoms'
2='no appreciable short term memory symptoms';
value long_memoryfmt
1='long term memory symptoms'
2='no appreciable long term memory symptoms';
value memory_cutofffmt
```

```
1='memory issues present'
2='no significant memory issues present';
value concentrationfmt
1='concentration issues present'
2='no concentration issues present';
value ADDfmt
1='ADD issues present'
2='no ADD issues present';
value math_abilityfmt
1='no issues with math ability'
2='issues with math ability';
value bumpingfmt
1='bumping into things frequently'
2='does not bump into things frequently';
value sadfmt
1='feels sad often'
2='does not feel sad often';
value cryfmt
1='cries easily'
2='does not cry easily';
value angerfmt
1='easy to anger'
2='not easy to anger';
value moodyfmt
1='often stressed or moody'
2='not often stressed or moody';
value OCDfmt
1='OCD tendencies present'
2='no OCD tendencies present';
value unresponsivefmt
1='feels emotionally unresponsive'
2='does not feel emotional unresponsive';
value nauseafmt
1='nausea present'
2='no nausea present';
value vomittingfmt
1='vomitting present'
2='no vomitting present';
value constipationfmt
1='constipation present'
2='no constipation present';
value diarrheafmt
1='diarrhea present'
2='no diarrhea present';
value low_sugarfmt
1='low blood sugar present'
2='no low blood sugar present';
value BMfmt
1='regular bowel movements'
2='less than regular bowel movements';
value diabetesfmt
1='takes diabetes medication'
2='does not take diabetes medication';
value GERDfmt
1='takes GERD medication'
2='does not take GERD medication';
value cholesterolfmt
1='high cholesterol'
```

```
        2='normal cholesterol';
        value triglyfmt
        1='high triglycerides'
        2='no high triglycerides';
        value weight_changefmt
        1='weight change issues'
        2='no weight change issues';
        value exercisefmt
        1='intense exercise'
        2='not intense exercise';
        value sleepfmt
        1='less than 6 hours of sleep'
        2='6 or more hours of sleep';
        value weight_lossfmt
        1='recent weight loss'
        2='no recent weight loss';
        value weight_gainfmt
        1='recent weight gain'
        2='no recent weight gain';
        value fat_gainfmt
        1='recent fat gain'
        2='no recent fat gain';
        value waist_fatfmt
        1='recent gain of fat in waist'
        2='no recent gain of fat in waist';
        value unable_weight_lossfmt
        1='unable to lose weight'
        2='not unable to lose weight';
        value suppfmt
        1='takes an iron supplement'
        2='does not take and iron supplement';
        value NIDYFfmt
        1='fatigued without ID'
        2='fatigued with ID';
        value NAYFfmt
        1='fatigued without anemia'
        2='fatigued with anemia';
        value ANFfmt
        1='anemia without fatigue'
        2='no anemia and no fatigue';
        value dizzy_SOB_cutofffmt
        1= 'dizziness and SOB not present'
        2= 'dizziness and SOB present';

*sorting & organizing the data;
proc sort data=all_data; by q100;
title 'sort all data';
proc print data=all_data;
title 'print all data';
      *means, standard error, min value and max value for all data;
proc means data = all_data n mean stderr min max;
var SCO_1 Q2--TIBC;
title 'means for all variables';
      *created a data set that excludes all participants that
      reported taking an antidepressant 'nearly every day';
proc sort data=no_antidep; by Q100;
proc print data=no_antidep;
```

```
*BIOCHEMICAL MARKERS;
      *correlation of anemia with iron deficient TIBC values (to check
to see if my TIBC
      values make sense
      --all those categorized as anemic should have high TIBC values--
      it did  not correlate well, so it seems that many people who are
anemic also
      have normal TIBC values.
      It is also statistically significant, so that is strange!
      This might mean TIBC values balance back out, or that they are
not a good/reliable
      measurement to use,
      or that we have too many normal-status folks to really view
      the relationship;
proc freq data=all_data;
      title 'Correlation of TIBC with anemia';
      title2 'biochemical markers';
      tables iron_status * TIBC_cutoff / CHISQ;
      format iron_status iron_statusfmt. TIBC_cutoff TIBC_cutofffmt.;
run;
      *Correlation of TIBC with other biochemical measures (to test to
see if my TIBC
      values make sense)--
      this isn't the relationship I was hoping for, as there is
essentially
      no relationship with any of them.  Note that I have also graphed
the data points in
      excel to see if
      there is a relationship that is not linear, and there is not;
proc corr data=all_data;
      title 'Correlation of TIBC with other Biochemical Measures';
      title2 'biochemical markers';
      var TIBC;
      with Hct Hb Ferritin;
run;
      *I am now looking at a frequency table of ferritin and TIBC by
cutoffs.  I know they don't
      relate well, but I am mostly just doing this to get the percent
of total
      subjects who have an abnormal TIBC reading;
proc freq data=all_data;
      Title 'Frequency Table of Ferritin cutoff to TIBC cutoff';
      title2 'biochemical markers';
      tables ferritin_cutoff * TIBC_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. TIBC_cutoff
TIBC_cutofffmt.;
run;
```

```
*COGNITION;
*DEPRESSION;
*depression overview;
proc print data=all_data;
var Q100 Q4_1     Q4_2  Q4_3  Q4_4  Q4_5  Q4_6  Q4_7  Q4_8  Q4_9 PHQ9;
      title 'depression screen values';
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      *running a print procedure to try to figure out why there are 159
subjects in the
      no_antidep dep_severity and dep_cutoff;
proc print data=all_data;
      title 'print of all data by sad, depseverity, depcutoff';
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      var Q100 sad dep_severity dep_cutoff;
      format sad sadfmt. dep_severity dep_severityfmt. dep_cutoff
dep_cutofffmt.;
run;
proc print data=no_antidep;
      title 'print of no antidep by sad, depseverity, depcutoff';
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      var Q100 sad dep_severity dep_cutoff;
      format sad sadfmt. dep_severity dep_severityfmt. dep_cutoff
dep_cutofffmt.;
run;
      *comparing data sets for numbers of depressed subjects;
proc freq data=all_data;
      title 'Frequency of depressed subjects in all data set';
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      tables dep_severity dep_cutoff;
      format dep_severity  dep_severityfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=no_antidep;
      title 'Frequency of depressed subjects in no anti-depressants
set';
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      tables dep_severity dep_cutoff;
      format dep_severity  dep_severityfmt. dep_cutoff dep_cutofffmt.;
run;
      *Now I am trying to figure out the subject codes that are
depressed to run the
      vitamin D analysis;
proc print data=no_antidep;
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      where dep_cutoff=2 and dep_severity>=3;
```

```
      var dep_cutoff dep_severity Q100;
run;
proc print data=no_antidep;
      title2 'overview';
      title3 'depression';
      title4 'cognition';
      where dep_cutoff=1 and dep_severity<3;
      var dep_cutoff dep_severity Q100;
run;
*depression and biochemical values;
      *correlation of hematocrit, hemoglobin, and ferritin values with
PHQ9;
proc corr data= all_data;
      title 'Correlation of iron measures with PHQ9 and Fatigue_Score';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      var HCT Hb Ferritin;
      with PHQ9 Q5_1--Q5_10 Fe_Def_symptom_Score;
run;
      *frequency table of depression severity and ferritin status;
proc freq data=no_antidep;
      Tables dep_severity * ferritin_status / CHISQ;
      Title'Depression Severity and Ferritin Status for no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      format dep_severity dep_severityfmt. ferritin_status
ferritin_statusfmt.;
run;
proc freq data=all_data;
      Tables dep_severity * ferritin_status / CHISQ;
      Title'Depression Severity and Ferritin Status for all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      format dep_severity dep_severityfmt. ferritin_status
ferritin_statusfmt.;
run;
      *frequency table of depression cutoff and ferritin cutoff;
proc freq data=no_antidep;
      Tables dep_cutoff * ferritin_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. ferritin_cutoff
ferritin_cutofffmt.;
      Title'Depression Cutoff and Ferritin Cutoff for no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
run;
proc freq data=all_data;
      Tables dep_cutoff * ferritin_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. ferritin_cutoff
ferritin_cutofffmt.;
      Title'Depression Cutoff and Ferritin Cutoff for all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
run;
```

```
      *frequency table of depression cutoff and anemia based on
hemoglobin or hematocrit;
proc freq data=no_antidep;
      Tables dep_cutoff * iron_status / CHISQ;
      format dep_cutoff dep_cutofffmt. iron_status iron_statusfmt.;
      Title'Anemia by Hb & Hct and depression no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
run;
proc freq data=all_data;
      Tables dep_cutoff * iron_status / CHISQ;
      format dep_cutoff dep_cutofffmt. iron_status iron_statusfmt.;
      Title'Anemia by Hb & Hct and depression all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
run;
      *Now I'm trying to get the right numbers for depression severity;
proc freq data=all_data;
      title 'ferritin cutoff and depression severity';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_severity * ferritin_cutoff / CHISQ;
      format dep_severity dep_severityfmt. ferritin_cutoff
ferritin_cutofffmt.;
run;
proc freq data=no_antidep;
      title 'ferritin cutoff and depression severity';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_severity * ferritin_cutoff / CHISQ;
      format dep_severity dep_severityfmt. ferritin_cutoff
ferritin_cutofffmt.;
run;
      *now I am just double checking my numbers with the fixed
no_antidep dataset for
      depression and anemia and depression and ID.;
proc freq data=no_antidep;
      title 'Frequency table of depression cutoff and anemia';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * iron_status / CHISQ;
      format dep_cutoff dep_cutofffmt. iron_status iron_statusfmt.;
run;
proc freq data=no_antidep;
      title 'Frequency table of depression cutoff and ID';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * ID / CHISQ;
      format dep_cutoff dep_cutofffmt. ID IDfmt.;
run;
      *Here I am looking at whether ID classified by two or more
abnormal iron measures
```

```
      (high TIBC and
      low ferritin) without anemia is associated with depression--
      all of the subjects in this freq table do not have anemia, and
one group has both
      abnormal TIBC and
      ferritin while the other has at least one normal measure.
      this data is really showing me that having two abnormal iron
measures without anemia
      is not a great
      predictor of depression;
proc freq data=no_antidep;
      Title 'Depression and ID without anemia by cutoffs-no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables ID_no_anemia * dep_cutoff /CHISQ;
      format ID_no_anemia ID_no_anemiafmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      Title 'Depression and ID without anemia by cutoffs-all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables ID_no_anemia * dep_cutoff /CHISQ;
      format ID_no_anemia ID_no_anemiafmt. dep_cutoff dep_cutofffmt.;
run;
      *Here I am looking at whether the group that has all abnormal
iron deficiency
      measures has a
      difference in depression instance than those that have all
      totally normal iron measures--this shows me that only two people
had all 4 measures
      of status
      as abnormal and only 9 people had all 4 measurs as normal.
      That is interesting in and of itself, but it means I do not have
enough subjects to
      analyze
      the data with these categories;
proc freq data=no_antidep;
      Title 'Frequency Table of Depression Cutoff and all abonormal
iron measures vs all
      normal iron measures-no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * ID_and_anemia / CHISQ;
      format dep_cutoff dep_cutofffmt. ID_and_anemia ID_and_anemiafmt.;
run;
proc freq data=all_data;
      Title 'Frequency Table of Depression Cutoff and all abonormal
iron measures vs all
      normal iron measures-all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * ID_and_anemia / CHISQ;
      format dep_cutoff dep_cutofffmt. ID_and_anemia ID_and_anemiafmt.;
run;
```

```
      *here I am looking at how well TIBC alone lines up with
depression--my data does not
      show TIBC alone as a good predictor of depression;
proc freq data=no_antidep;
      Title 'Depression Cutoff and TIBC Cutoff-no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * TIBC_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. TIBC_cutoff TIBC_cutofffmt.;
run;
proc freq data=all_data;
      Title 'Depression Cutoff and TIBC Cutoff-all_data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * TIBC_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. TIBC_cutoff TIBC_cutofffmt.;
run;
      *Here I am looking at the TIBC ferritin combination and
depression by cutoff--this
      does not seem to be a good indicator of depression;
proc freq data=no_antidep;
      title 'Frequency Table of ID by both TIBC and Ferritin with
Depression by
      cutoff-no_antidep';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * ID / CHISQ;
      format dep_cutoff dep_cutofffmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency Table of ID by both TIBC and Ferritin with
Depression by
      cutoff-all data';
      title2 'biochemical values and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * ID / CHISQ;
      format dep_cutoff dep_cutofffmt. ID IDfmt.;
run;
*depression and symptomatic ID;
      *IMPORTANT: frequency table of depression cutoff and functional
iron deficiency
      symptoms cutoff;
proc freq data=no_antidep;
      title 'Frequency table of functional iron deficiency symptoms
cutoff and
      depression cutoff-no_antidep';
      title2 'symptomatic ID and depression';
      title3 'depression';
      title4 'cognition';
      tables Func_iron_def_symp_cutoff * dep_cutoff /CHISQ;
      format func_iron_def_symp_cutoff func_iron_def_symp_cutofffmt.
dep_cutoff
      dep_cutofffmt.;
run;
```

```
proc freq data=all_data;
      title 'Frequency table of functional iron deficiency symptoms
cutoff and
      depression cutoff-all_data';
      title2 'symptomatic ID and depression';
      title3 'depression';
      title4 'cognition';
      tables Func_iron_def_symp_cutoff * dep_cutoff /CHISQ;
      format func_iron_def_symp_cutoff func_iron_def_symp_cutofffmt.
dep_cutoff
      dep_cutofffmt.;
run;
*depression and biochemical & symptomatic ID;
      *frequency table of sum of iron deficiency symptoms cutoff and
depression cutoff;
proc freq data=no_antidep;
      title 'sum of iron deficiency symptoms vs depression-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      Tables  Fe_Def_symptom_score * dep_cutoff /CHISQ;
      format dep_cutoff dep_cutofffmt. Fe_Def_symptom_score
Fe_Def_symptom_scorefmt.;
run;
      *frequency table of sum of iron deficiency symptoms cutoff and
depression cutoff;
proc freq data=all_data;
      title 'sum of iron deficiency symptoms vs depression-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      Tables  Fe_Def_symptom_score * dep_cutoff /CHISQ;
      format dep_cutoff dep_cutofffmt. Fe_Def_symptom_score
Fe_Def_symptom_scorefmt.;
run;
      *IMPORTANT TABLE: frequency table of anemia based on hematocrit
or
      hemoglobin + fatigue and depression cutoff, this is what we used
to make
      the table of
      functional iron deficiency for CTSI poster;
proc freq data=no_antidep;
      title 'functional iron deficiency (anemia and fatigue) and
depression
      no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      Tables function_def * dep_cutoff / CHISQ;
      format function_def function_deffmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'functional iron deficiency (anemia and fatigue) and
depression all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      Tables function_def * dep_cutoff / CHISQ;
```

```
      format function_def function_deffmt. dep_cutoff dep_cutofffmt.;
run;
      *IMPORTANT: stepwise regression of PHQ9, Q5 independently,
hemoglobin, hematocrit,
      and ferritin--showed us which 6 symptoms from Q5 to focus on for
future analysis;
proc reg  data=no_antidep;
      title 'Stepwise regression of iron def symptoms and biochem
measures with
      PHQ9-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      format dep_severity dep_severityfmt. q5_1 q4fmt.;
      var PHQ9 Q5_1--Q5_10 Hct Hb   Ferritin ;
      model PHQ9=Q5_1--Q5_10 Hct Hb Ferritin/selection=stepwise;
run;
proc reg  data=all_data;
      title 'Stepwise regression of iron def symptoms and biochem
measures with
      PHQ9-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      format dep_severity dep_severityfmt. q5_1 q4fmt.;
      var PHQ9 Q5_1--Q5_10 Hct Hb   Ferritin ;
      model PHQ9=Q5_1--Q5_10 Hct Hb Ferritin/selection=stepwise;
run;
      *Also important: frequency table of depression cutoff and select
iron
      deficiency symptoms cutoff;
proc freq data=no_antidep;
      title 'Frequency table of select iron deficiency symptoms cutoff
and
      depression cutoff-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables select_iron_def_symp_cutoff * dep_cutoff /CHISQ;
      format select_iron_def_symp_cutoff
select_iron_def_symp_cutofffmt.
      dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of select iron deficiency symptoms cutoff
and
      depression cutoff-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables select_iron_def_symp_cutoff * dep_cutoff /CHISQ;
      format select_iron_def_symp_cutoff
select_iron_def_symp_cutofffmt.
      dep_cutoff dep_cutofffmt.;
run;
      *Quite important: frequency table of depression cutoff with
select
      iron def symptions/anemia;
```

```
proc freq data=no_antidep;
      title 'Frequency table of select iron deficiency symptoms
cutoff/anemia and
      depression cutoff-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_select_Fe_def_sym_cutoff * dep_cutoff /CHISQ;
      format anemia_select_Fe_def_sym_cutoff
anemia_select_Fe_def_sym_cutofffmt.
      dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of select iron deficiency symptoms
cutoff/anemia and
      depression cutoff-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_select_Fe_def_sym_cutoff * dep_cutoff /CHISQ;
      format anemia_select_Fe_def_sym_cutoff
anemia_select_Fe_def_sym_cutofffmt.
      dep_cutoff dep_cutofffmt.;
run;
      *IMPORTANT: Here I am looking at the TIBC, ferritin, and fatigue
combination
      and depression-
      -basically if you are ID and also fatigued you have a 47% chance
of moderate
      to severe depression while if you are ID but are not experiencing
fatigue
      you have a 7%
      chance of depression.  Note that much of the dataset is
eliminated from this
      freq table, so I am not sure if it is appropriate, but if follows
the same
      pattern as what
      I saw with anemia and fatigue.  Is this showing that fatigue with
ID measures
      is a good indicator of depression?;
proc freq data=no_antidep;
      Title 'Frequency Table of TIBC, Ferritin, and Fatigue with
Depression
      cutoff-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables TIBC_Ferritin_fatigue * dep_cutoff / CHISQ;
      format TIBC_Ferritin_fatigue TIBC_Ferritin_fatiguefmt. dep_cutoff
dep_cutofffmt.;
run;
proc freq data=all_data;
      Title 'Frequency Table of TIBC, Ferritin, and Fatigue with
      Depression cutoff-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables TIBC_Ferritin_fatigue * dep_cutoff / CHISQ;
```

```
      format TIBC_Ferritin_fatigue TIBC_Ferritin_fatiguefmt. dep_cutoff
dep_cutofffmt.;
      *now I am looking at fatigue and depression in general to
            add to the sigma plot graphs;
proc freq data=no_antidep;
      title 'fatigue and depression-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables fatigue * dep_cutoff / CHISQ;
      format fatigue fatiguefmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'fatigue and depression-all data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables fatigue * dep_cutoff / CHISQ;
      format fatigue fatiguefmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=no_antidep;
      title 'fatigue with ID and depression-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables NIDYF * dep_cutoff / CHISQ;
      format NIDYF NIDYFfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'fatigue with ID and depression-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables NIDYF * dep_cutoff / CHISQ;
      format NIDYF NIDYFfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=no_antidep;
      title 'fatigue with anemia and depression-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables NAYF * dep_cutoff / CHISQ;
      format NAYF NAYFfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'fatigue with anemia and depression-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables NAYF * dep_cutoff / CHISQ;
      format NAYF NAYFfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=no_antidep;
      title 'fatigue with anemia and depression-no_antidep';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables ANF * dep_cutoff / CHISQ;
```

```
      format ANF ANFfmt. dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'fatigue with anemia and depression-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables ANF * dep_cutoff / CHISQ;
      format ANF ANFfmt. dep_cutoff dep_cutofffmt.;
run;
      *looking at the select symptoms without headaches (just SOB and
dizziness)
      with depression;
proc freq data=all_data;
      title 'Frequency table of dizzy+SOB cutoff/anemia and depression
      cutoff-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_dizzy_SOB_cutoff * dep_cutoff /CHISQ;
      format anemia_dizzy_SOB_cutoff  anemia_dizzy_SOB_cutofffmt.
      dep_cutoff dep_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of dizzy+SOB cutoff/anemia and ease of
anger-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_dizzy_SOB_cutoff * anger /CHISQ;
      format anemia_dizzy_SOB_cutoff  anemia_dizzy_SOB_cutofffmt. anger
angerfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of dizzy+SOB cutoff/anemia and
stress/moody-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_dizzy_SOB_cutoff * moody /CHISQ;
      format anemia_dizzy_SOB_cutoff  anemia_dizzy_SOB_cutofffmt. moody
moodyfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of dizzy+SOB cutoff/anemia and emotional
      unresponsiveness-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      tables anemia_dizzy_SOB_cutoff * unresponsive /CHISQ;
      format anemia_dizzy_SOB_cutoff  anemia_dizzy_SOB_cutofffmt.
      unresponsive unresponsivefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of dizzy+SOB cutoff/anemia and
alert/concentration-all_data';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
```

```
      title4 'cognition';
      tables anemia_dizzy_SOB_cutoff * concentration /CHISQ;
      format anemia_dizzy_SOB_cutoff  anemia_dizzy_SOB_cutofffmt.
      concentration concentrationfmt.;
run;
proc corr data=no_antidep pearson spearman kendall hoeffding;
      title 'Correlation of iron status parameters with depression';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      var Hct Hb ferritin TIBC Q5_1 select_symptoms_score;
      with PHQ9;
run;
proc sort data=all_data; by Q5_1 Hct Hb PHQ9;
proc boxplot data=all_data;
      title 'Boxplot of Hct Hb PHQ9 select symptoms score vs. fatigue';
      title2 'depression and biochemical & symptomatic ID';
      title3 'depression';
      title4 'cognition';
      plot (Hct Hb PHQ9 select_symptoms_score)*Q5_1;
run;
proc sort data=no_antidep; by PHQ9;
proc boxplot data=no_antidep;
      title 'Boxplot of Hct Hb select symptoms vs. depression';
      plot (Hct Hb select_symptoms_score)*PHQ9;
run;
*depression and diet
      *frequency table of depression cutoff and vegetarian/meat eater
classification;
proc freq data=all_data;
      Tables dep_cutoff * meat_status / CHISQ;
      format dep_cutoff dep_cutofffmt. meat_status meat_statusfmt.;
      Title 'Chi Square Test of Meat Status and Depression Cutoff';
      title2 'diet and depression';
      title3 'depression';
      title4 'cognition';
run;
      *frequency table of depression cutoff and amount of meat
eaten/week;
proc freq data=all_data;
      Tables dep_cutoff * meat_consumption / CHISQ;
      Title 'Chi Square Test of Meat Consumption and Depression
Cutoff';
      title2 'diet and depression';
      title3 'depression';
      title4 'cognition';
run;
*depression and BMI;
      *now I am looking at depression severity and BMI;
proc freq data=no_antidep;
      title 'depression and BMI-no_antidep';
      title2 'BMI and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_severity * BMI_status / CHISQ;
      format dep_severity dep_severityfmt. BMI_status BMI_statusfmt.;
run;
proc freq data=no_antidep;
```

```
      title 'depression and BMI by cutoff-no_antidep';
      title2 'BMI and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * BMI_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. BMI_cutoff BMI_cutofffmt.;
run;
proc freq data=all_data;
      title 'depression and BMI-all_data';
      title2 'BMI and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_severity * BMI_status / CHISQ;
      format dep_severity dep_severityfmt. BMI_status BMI_statusfmt.;
run;
proc freq data=all_data;
      title 'depression and BMI by cutoff-all_data';
      title2 'BMI and depression';
      title3 'depression';
      title4 'cognition';
      tables dep_cutoff * BMI_cutoff / CHISQ;
      format dep_cutoff dep_cutofffmt. BMI_cutoff BMI_cutofffmt.;
run;
*EXECUTIVE FUNCTIONING--Q6;
      *anemia based on hemoglobin and hematocrit and the
      sum of memory/learning/concentration issues;
proc freq data=all_data;
      Tables iron_status * learning_status / CHISQ;
      Title 'Learning Issues and Hb and Hct Cutoff';
      title3 'executive functioning';
      title4 'cognition';
      format iron_status iron_statusfmt. learning_status
learning_statusfmt.;
run;
      *frequency table of the 6 important function iron deficiency
symptoms by
      cutoff and the sum of memory/learning/concentration issues;
proc freq data=all_data;
      Tables func_iron_def_symp_cutoff * learning_status / CHISQ;
      Title 'Chi Square Test of Learning/Memory and the 6 Important
      Functional Iron Deficiency Symptoms by cutoff';
      title3 'executive functioning';
      title4 'cognition';
run;
      *Now I am going to look more closely at Memory and Learning, Q6;
      *This is the three types of memory with anemia;
proc freq data=all_data;
      title 'Frequency table of short term memory and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables short_memory * iron_status / CHISQ;
      format short_memory short_memoryfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: treding to significance;
proc freq data=all_data;
      title 'Frequency table of long term memory and anemia';
      title3 'executive functioning';
      title4 'cognition';
```

```
      tables long_memory * iron_status / CHISQ;
      format long_memory long_memoryfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: significant;
proc freq data=all_data;
      title 'Frequency table of total memory and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables memory_cutoff * iron_status / CHISQ;
      format memory_cutoff memory_cutofffmt. iron_status
iron_statusfmt.;
run;
      *This is the three types of memory with anemia+fatigue;
      *IMPORTANT: significant----not significant when just anemia.
      Fatigue may help correlate these;
proc freq data=all_data;
      title 'Frequency table of short term memory and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables short_memory * function_def / CHISQ;
      format short_memory short_memoryfmt. function_def
function_deffmt.;
run;
      *IMPORTANT: trending to significance;
proc freq data=all_data;
      title 'Frequency table of long term memory and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables long_memory * function_def / CHISQ;
      format long_memory long_memoryfmt. function_def function_deffmt.;
run;
      *IMPORTANT: very significant;
proc freq data=all_data;
      title 'Frequency table of total memory and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables memory_cutoff * function_def / CHISQ;
      format memory_cutoff memory_cutofffmt. function_def
function_deffmt.;
run;
      *This is the three types of memory with ID;
proc freq data=all_data;
      title 'Frequency table of short term memory and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables short_memory * ID / CHISQ;
      format short_memory short_memoryfmt. ID IDfmt.;
run;
      *IMPORTANT: trending towards significant but when add fatigue
(below) becomes
      significant long term memory and ID;
proc freq data=all_data;
      title 'Frequency table of long term memory and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables long_memory * ID / CHISQ;
      format long_memory long_memoryfmt. ID IDfmt.;
run;
```

```
proc freq data=all_data;
      title 'Frequency table of total memory and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables memory_cutoff * ID / CHISQ;
      format memory_cutoff memory_cutofffmt. ID IDfmt.;
run;
      *This is the three types of memory with ID+fatigue;
proc freq data=all_data;
      title 'Frequency table of short term memory and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables short_memory * TIBC_ferritin_fatigue / CHISQ;
      format short_memory short_memoryfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *IMPORTANT: long term memory is statistically significant for
ID+fatigue when
      only trending that way with just ID;
proc freq data=all_data;
      title 'Frequency table of long term memory and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables long_memory * TIBC_ferritin_fatigue / CHISQ;
      format long_memory long_memoryfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of total memory and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables memory_cutoff * TIBC_ferritin_fatigue / CHISQ;
      format memory_cutoff memory_cutofffmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I'm looking at concentration with all iron measures;
proc freq data=all_data;
      title 'Frequency table of concentration and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables concentration * iron_status / CHISQ;
      format concentration concentrationfmt. iron_status
iron_statusfmt.;
run;
      *IMPORTANT: very significant with fatigue but not significant
without it!;
proc freq data=all_data;
      title 'Frequency table of concentration and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables concentration * function_def / CHISQ;
format concentration concentrationfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of concentration and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables concentration * ID / CHISQ;
```

```
      format concentration concentrationfmt. ID IDfmt.;
run;
      *IMPORTANT: very significant with fatigue but not significant
without it!;
proc freq data=all_data;
      title 'Frequency table of concentration and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables concentration * TIBC_ferritin_fatigue / CHISQ;
      format concentration concentrationfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I'm looking at ADD with all iron measures--kind of trending
there more
      with anemia and fatigue but no significant findings;
proc freq data=all_data;
      title 'Frequency table of ADD and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables ADD * iron_status / CHISQ;
      format ADD ADDfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ADD and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables ADD * function_def / CHISQ;
      format ADD ADDfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ADD and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables ADD * ID / CHISQ;
      format ADD ADDfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ADD and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables ADD * TIBC_ferritin_fatigue / CHISQ;
      format ADD ADDfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I'm looking at math ability with all iron measures--nothing;
proc freq data=all_data;
      title 'Frequency table of math ability and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables math_ability * iron_status / CHISQ;
      format math_ability math_abilityfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of math ability and anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables math_ability * function_def / CHISQ;
```

```
      format math_ability math_abilityfmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of math ability and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables math_ability * ID / CHISQ;
      format math_ability math_abilityfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of math ability and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables math_ability * TIBC_ferritin_fatigue / CHISQ;
      format math_ability math_abilityfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I'm looking at bumping into things with all iron measures--
nothing;
proc freq data=all_data;
      title 'Frequency table of bumping into things and anemia';
      title3 'executive functioning';
      title4 'cognition';
      tables bumping * iron_status / CHISQ;
      format bumping bumpingfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of bumping into things and
anemia+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables bumping * function_def / CHISQ;
      format bumping bumpingfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of bumping into things and ID';
      title3 'executive functioning';
      title4 'cognition';
      tables bumping * ID / CHISQ;
      format bumping bumpingfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of bumping into things and ID+fatigue';
      title3 'executive functioning';
      title4 'cognition';
      tables bumping * TIBC_ferritin_fatigue / CHISQ;
      format bumping bumpingfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
      *IMPORTANT: I am now looking at anemia and fatigue with
            learning status--this approaches
      significance while it does not when run without fatigue;
proc freq data=all_data;
      title 'Frequency table of anemia and fatigue with learning';
      title3 'executive functioning';
      title4 'cognition';
      tables function_def * learning_status / CHISQ;
```

```
      format function_def function_deffmt. learning_status
learning_statusfmt.;
run;
      *I am now looking at ID (by TIBC and Ferritin) and fatigue with
learning status;
proc freq data=all_data;
      title 'Frequency table of ID (by TIBC and Ferritin) and fatigue
with learning';
      title3 'executive functioning';
      title4 'cognition';
      tables TIBC_Ferritin_fatigue * learning_status / CHISQ;
      format TIBC_Ferritin_fatigue TIBC_Ferritin_fatiguefmt.
learning_status
      learning_statusfmt.;
run;
*OTHER AFFECTIVE DISORDERS--Q7;
      *frequency table of anemia based on hemoglobin and hematocrit and
      the sum of emotional issues;
proc freq data=all_data;
      Tables iron_status * emotion_status / CHISQ;
      Title 'Emotional Issues and Hemoglobin and Hematocrit Cutoff';
      Title3 'other affective';
      title4 'cognition';
      format iron_status iron_statusfmt. emotion_status
emotion_statusfmt.;
run;
      *frequency table of emotional issues and the 6 important
functional iron
      deficieny symptoms by cutoff;
proc freq data=all_data;
      Tables func_iron_def_symp_cutoff * emotion_status / CHISQ;
      Title 'Chi Square Test of Emotional Issues and the 6 Important
      Functional Iron Deficiency Symptoms by cutoff';
      Title3 'other affective';
      title4 'cognition';
run;
      *Now I am going to break down Q7--emotion--more closely for all
iron measures;
      *now I'm looking at feelings sad often and all iron measures;
proc freq data=all_data;
      title 'Frequency table of feeling sad and anemia';
      Title3 'other affective';
      title4 'cognition';
      tables sad * iron_status / CHISQ;
      format sad sadfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of feeling sad and anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables sad * function_def / CHISQ;
      format sad sadfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of feelingn sad and ID';
      Title3 'other affective';
      title4 'cognition';
      tables sad * ID / CHISQ;
```

```
      format sad sadfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of feeling sad and ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables sad * TIBC_ferritin_fatigue / CHISQ;
      format sad sadfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I'm going to look at crying easily and all the iron
measures;
proc freq data=all_data;
      title 'Frequency table of crying easily and anemia';
      Title3 'other affective';
      title4 'cognition';
      tables cry * iron_status / CHISQ;
      format cry cryfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of crying easily and anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables cry * function_def / CHISQ;
      format cry cryfmt. function_def function_deffmt.;
run;
      *IMPORTANT: significant;
proc freq data=all_data;
      title 'Frequency table of crying easily and ID';
      Title3 'other affective';
      title4 'cognition';
      tables cry * ID / CHISQ;
      format cry cryfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of crying easily and ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables cry * TIBC_ferritin_fatigue / CHISQ;
      format cry cryfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at easy to anger and all iron measures;
proc freq data=all_data;
      title 'Frequency table of easy to anger and anemia';
      Title3 'other affective';
      title4 'cognition';
      tables anger * iron_status / CHISQ;
      format anger angerfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: very significant when add fatigue but not without
fatigue!;
proc freq data=all_data;
      title 'Frequency table of easy to anger and anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables anger * function_def / CHISQ;
      format anger angerfmt. function_def function_deffmt.;
```

```
run;
proc freq data=all_data;
      title 'Frequency table of easy to anger and ID';
      Title3 'other affective';
      title4 'cognition';
      tables anger * ID / CHISQ;
      format anger angerfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of easy to anger and ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables anger * TIBC_ferritin_fatigue / CHISQ;
      format anger angerfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at feeling stressed and/or moody with all iron
measures;
proc freq data=all_data;
      title 'Frequency table of stressed/moody and anemia';
      Title3 'other affective';
      title4 'cognition';
      tables moody * iron_status / CHISQ;
      format moody moodyfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: this became VERY significant when you add fatigue but
was not
      significant without fatigue;
proc freq data=all_data;
      title 'Frequency table of stressed/moody and anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables moody * function_def / CHISQ;
      format moody moodyfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of stressed/moody and ID';
      Title3 'other affective';
      title4 'cognition';
      tables moody * ID / CHISQ;
      format moody moodyfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of stressed/moody and ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables moody * TIBC_ferritin_fatigue / CHISQ;
      format moody moodyfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at OCD tendencies and all iron measures;
      *IMPORTANT: very significant for all anemia!;
proc freq data=all_data;
      title 'Frequency table of OCD and anemia';
      Title3 'other affective';
      title4 'cognition';
      tables OCD * iron_status / CHISQ;
      format OCD OCDfmt. iron_status iron_statusfmt.;
```

```
run;
      *IMPORTANT:very significant for all anemia!;
proc freq data=all_data;
      title 'Frequency table of OCD and anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables OCD * function_def / CHISQ;
      format OCD OCDfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of OCD and ID';
      Title3 'other affective';
      title4 'cognition';
      tables OCD * ID / CHISQ;
      format OCD OCDfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of OCD and ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables OCD * TIBC_ferritin_fatigue / CHISQ;
      format OCD OCDfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I'm looking at feeling emotionally unresponsive and all iron
measures;
proc freq data=all_data;
      title 'Frequency table of feeling emotionally unresponsive and
anemia';
      Title3 'other affective';
      title4 'cognition';
      tables unresponsive * iron_status / CHISQ;
      format unresponsive unresponsivefmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: this is signficant with fatigue but not without
fatigue for anemia!;
proc freq data=all_data;
      title 'Frequency table of feeling emotionally unresponsive and
anemia+fatigue';
      Title3 'other affective';
      title4 'cognition';
      tables unresponsive * function_def / CHISQ;
      format unresponsive unresponsivefmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of feeling emotionally unresponsive and
ID';
      Title3 'other affective';
      title4 'cognition';
      tables unresponsive * ID / CHISQ;
      format unresponsive unresponsivefmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of feeling emotionally unresponsive and
ID+fatigue';
      Title3 'other affective';
      title4 'cognition';
```

```
      tables unresponsive * TIBC_ferritin_fatigue / CHISQ;
      format unresponsive unresponsivefmt. TIBC_ferritin_fatigue
      TIBC_ferritin_fatiguefmt.;
run;
      *Now I am going to look a little closer at anxiety-not really
sure how best
      to analyze this.  ferritin was significant
      but with a small R2;
proc corr data=all_data;
      title 'correlation of taking anti-anxiety medication and
biochemical measures';
      Title3 'other affective';
      title4 'cognition';
      var Q18_3;
      with Hct Hb ferritin TIBC;
run;
      *now I am looking to get values for anemia and ease of anger,
stress/moodiness,
      alertness and concentration, emotionally unresponsive;
proc freq data=all_data;
      title 'fatigue/anemia and ease of anger';
      Title3 'other affective';
      title4 'cognition';
      tables NAYF * anger / CHISQ;
      format NAYF NAYFfmt. anger angerfmt.;
proc freq data=all_data;
      title 'fatigue/anemia and ease of anger';
      Title3 'other affective';
      title4 'cognition';
      tables ANF * anger / CHISQ;
      format ANF ANFfmt. anger angerfmt.;
run;
proc freq data=all_data;
      title 'fatigue/anemia and stress/moodiness';
      Title3 'other affective';
      title4 'cognition';
      tables NAYF * moody / CHISQ;
      format NAYF NAYFfmt. moody moodyfmt.;
proc freq data=all_data;
      title 'fatigue/anemia and stress/moodiness';
      Title3 'other affective';
      title4 'cognition';
      tables ANF * moody / CHISQ;
      format ANF ANFfmt. moody moodyfmt.;
run;
proc freq data=all_data;
      title 'fatigue/anemia and alertness/concentration';
      Title3 'other affective';
      title4 'cognition';
      tables NAYF * concentration / CHISQ;
      format NAYF NAYFfmt. concentration concentrationfmt.;
proc freq data=all_data;
      title 'fatigue/anemia and alertness/concentration';
      Title3 'other affective';
      title4 'cognition';
      tables ANF * concentration / CHISQ;
      format ANF ANFfmt. concentration concentrationfmt.;
run;
```

```
proc freq data=all_data;
      title 'fatigue/anemia and emotionally unresponsive';
      Title3 'other affective';
      title4 'cognition';
      tables NAYF * unresponsive / CHISQ;
      format NAYF NAYFfmt. unresponsive unresponsivefmt.;
proc freq data=all_data;
      title 'fatigue/anemia and emotionally unresponsive';
      Title3 'other affective';
      title4 'cognition';
      tables ANF * unresponsive / CHISQ;
      format ANF ANFfmt. unresponsive unresponsivefmt.;
run;
      *IMPORTANT: I am now going to look at anemia and fatigue with
      emotion status---this approaches
      significance while it does not when run without fatigue;
proc freq data=all_data;
      title 'Frequency table of anemia and fatigue with emotion';
      Title3 'other affective';
      title4 'cognition';
      tables function_def * emotion_status / CHISQ;
      format function_def function_deffmt. emotion_status
emotion_statusfmt.;
run;
      *I am now looking at ID with fatigue and emotion status;
proc freq data=all_data;
      title 'Frequency table of ID (by ferritin and TIBC) and fatigue
with emotion';
      Title3 'other affective';
      title4 'cognition';
      tables TIBC_Ferritin_fatigue * emotion_status / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt.
emotion_status
      emotion_statusfmt.;
run;
*COGNITION COMBINATIONS;
      *means, standard error, and min and max values of depression and
other affective
      disorders in the no_antidep dataset;
proc means data=no_antidep n mean stderr min max;
      var SCO_1 PHQ9 Q4_1 Q4_2 Q4_3 Q4_4 dep_severity dep_cutoff
      ferritin_status iron_status;
      title 'means of no_antidep depression and other affective
disorders';
      title3 'cognition combinations';
      title4 'cognition';
      *correlation of PHQ9, Q4, Q5,depression severity catagories, and
      iron deficiency symptom score with ferritin cutoff values and
anemia based on
      hematocrit and hemoglobin;
proc corr data= no_antidep;
      title 'Subjects not taking antidepressants -
      correlation of iron measures with depression severity';
      title3 'cognition combinations';
      title4 'cognition';
      var ferritin_status iron_status;
      with PHQ9 Q4_1 Q4_2 Q4_3 Q4_4 Q4_5 Q4_6 Q4_7 Q4_8 Q4_9 Q5_1--
Q5_10
```

```
      dep_severity Fe_Def_symptom_Score;
run;
      *plot of hemoglobin, hematocrit, and ferritin values with PHQ9
score,
      Q4 individuals, Q5 individuals, and sum of iron deficiency
symptoms;
proc plot data = no_antidep;
      title 'plot of iron measures with PHQ9 and Fatigue_Score';
      title3 'cognition combinations';
      title4 'cognition';
      plot (HCT Hb Ferritin) * (PHQ9 Q4_1 Q4_2 Q4_3 Q4_4 Q4_5 Q4_6 Q4_7
Q4_8
      Q4_9 Q5_1--Q5_10 Fe_Def_symptom_Score);
run;
proc plot data=all_data;
      title 'plot of Hct Hb PHQ9 select symptoms vs. fatigue - all
data';
      title3 'cognition combinations';
      title4 'cognition';
      plot (Hct Hb PHQ9 select_symptoms_score)*Q5_1;
run;
proc plot data=no_antidep;
      title 'plot of Hct Hb select symptoms vs. depression - exclusion
of those on
      antidepressants';
      title3 'cognition combinations';
      title4 'cognition';
      plot (Hct Hb Q5_1 select_symptoms_score)*PHQ9;
run;
```

```
*IRON DEFICIENCY SYMPTOMS--Q5;
*Biochemical values and ID symptoms from Q5
      *plot of hematorcrit, hemoglobin, and ferritin vlaues with
      iron deficiency symptoms score - sum of Q5;
proc plot data = all_data;
      title 'plot of iron measures with PHQ9 and Fe_Def_Score';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      plot (HCT Hb Ferritin) * (PHQ9 Q5_1--Q5_10 Fe_Def_symptom_Score);
run;
      *frequency table of iron deficiency symptoms (sum of Q5)
      and anemia based on hemoglobin and hematocrit and ferritin
cutoff;
proc freq data=all_data;
      Tables Q5_1--Q5_10 * (iron_status ferritin_cutoff) / CHISQ;
      Title 'Iron def symptoms vs iron status - chi square';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      format Q5_1--Q5_10 Q4fmt. iron_status iron_statusfmt.;
run;
```

```
      *correlation of iron deficiency symptom score with hemoglobin,
hematocrit,
      and ferritin;
proc corr data=all_data;
      title 'Correlation of deficiency symptoms with biochem measures';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      var Fe_Def_symptom_Score;
      with Hct Hb Ferritin;
run;
      *correlation of both the fatigue questions -- also iron
deficiency symptom score
      and sum/cutoff;
proc corr data=no_antidep;
      title 'Correlation of two fatigue questions';
      title3 'ID symptoms Q5';
      var Q4_4;
      with q5_1 Fe_Def_symptom_score;
run;
      *correlation of 6 important functional iron deficiency symptoms
score
      with biochemical measures;
proc corr data=all_data;
      title 'Correlation of 6 important functional iron deficiency
symptoms
      with biochemical measures';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      var important_symptoms_score;
      with Hct Hb Ferritin TIBC;
run;
      *frequency table of anemia with 6 functional iron deficiency
symptoms cutoff;
proc freq data=all_data;
      title 'Frequency table of anemia cutoff and 6 functional iron
deficiency
      symptoms cutoff';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables func_iron_def_symp_cutoff * iron_status /CHISQ;
      format func_iron_def_symp_cutoff func_iron_def_symp_cutofffmt.
iron_status
      iron_statusfmt.;
run;
      *IMPORTANT: Here I am looking at the ID without anemia group and
fatigue--
      it appears that this
      data is APPROACHING significance with a pvalue of 0.07.  It
appears
      this group of ID and no anemia is more likely to be fatigued as
well;
proc freq data=no_antidep;
      title 'Frequency Table of ID without anemia and fatigue
no_antidep';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID_no_anemia * fatigue /CHISQ;
      format ID_no_anemia ID_no_anemiafmt. fatigue fatiguefmt.;
```

```
run;
proc freq data=all_data;
      title 'Frequency Table of ID without anemia and fatigue
all_data';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID_no_anemia * fatigue /CHISQ;
      format ID_no_anemia ID_no_anemiafmt. fatigue fatiguefmt.;
run;
      *here I am looking at TIBC alone with the sum of iron deficiency
symptoms--
      it doesn't
      seem to be a good predictor alone of the sum of ID symptoms;
proc corr data=all_data;
      title 'Correlation of TIBC with sum of iron deficiency symptoms';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      var TIBC;
      with Fe_Def_symptom_score;
run;
      *here I am looking at TIBC alone with the 6 important symptoms--
it doesn't
      seem to be a
      good predictor alone of the sume of important ID symptoms;
proc corr data=all_data;
      title 'Correlation of TIBC with sum of important ID symptoms';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      var TIBC;
      with important_symptoms_score;
run;
      *running ferritin and fatigue;
proc freq data=all_data;
      title 'ferritin and fatigue';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ferritin_cutoff * fatigue / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. fatigue fatiguefmt.;
run;
      *here I am looking at TIBC alone with fatigue--it doesn't seem to
be a
      good predictor
      alone of frequent fatigue;
proc freq data=all_data;
      title 'Frequency Table of TIBC with fatigue';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables fatigue * TIBC_cutoff / CHISQ;
      format fatigue fatiguefmt. TIBC_cutoff TIBC_cutofffmt.;
run;
      *IMPORTANT:here I combined TIBC and Ferritin together and looked
at fatigue--these
      results tell me that there are 45 people who are ID by both
abnormal TIBC and ferritin
      readings, and that the likelihood of reporting fatigue is
STATISTICALLY SIGNIFANTLY
      higher in this group than in the group that does not have both
abnormal TIBC and
```

```
      ferritin.;
proc freq data=no_antidep;
      title 'Frequency Table of ID by both TIBC and Ferritin with
fatigue no_antidep';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables fatigue * ID / CHISQ;
      format fatigue fatiguefmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency Table of ID by both TIBC and Ferritin with
fatigue all_data';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables fatigue * ID / CHISQ;
      format fatigue fatiguefmt. ID IDfmt.;
run;
      *here I am looking at ferritin alone with fatigue. This is just
verifying
      what I found
      in the frequency table above this one, where TIBC and ferritin
ALONE
      are not
      good predictors of fatigue, but if both are abnormal then that
combination
      is a good
      predictor of fatgue;
proc freq data=all_data;
      title 'Frequency Table of Ferritin status and Fatigue';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables fatigue * ferritin_cutoff /CHISQ;
      format fatigue fatiguefmt. ferritin_cutoff ferritin_cutofffmt.;
run;
      *Here I am looking at the TIBC ferritin combination and the
important
      symptoms, or what
      we called functional ID--the combination of ferritin and TIBC
does
      not seem
      to be a good predictor of the 6 important symptoms cutoff that we
      called functional ID;
proc freq data=all_data;
      Title 'Frequency Table of ID by both TIBC and Ferritin with
Functional ID';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables func_iron_def_symp_cutoff * ID / CHISQ;
      format func_iron_def_symp_cutoff func_iron_def_symp_cutofffmt. ID
IDfmt.;
run;
*Here I am looking at the TIBC ferritin combination and the total ID
symptoms;
proc freq data=all_data;
      Title 'Frequency Table of ID by both TIBC and Ferritin with all
ID sypmtoms (Q5)';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
```

```
      tables fe_def_symptom_score * ID /CHISQ;
      format fe_def_symptom_score fe_def_symptom_scorefmt. ID IDfmt.;
run;
      *IMPORTANT: I am now looking at a frequency table of ID and
fatigue
      to the six important
      symptoms cutoff to see if they correlate well.  I cannot tell if
the numbers
      are too small to draw any significance from this table, but it
looks
      like if you have no
      fatigue and no ID, your likelihood of the 6 important symptoms,
which also
      predict depression, is very low.  If you have ID and fatigue, the
      likelihood is higher,
      but the numbers are very small;
proc freq data=all_data;
      Title 'Frequency Table of ID and fatigue to the six imporant
symptoms score';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables TIBC_Ferritin_fatigue * func_iron_def_symp_cutoff / CHISQ;
      format TIBC_Ferritin_fatigue TIBC_Ferritin_fatiguefmt.
      func_iron_def_symp_cutoff
      func_iron_def_symp_cutofffmt.;
run;
      *I want to double check that I ran an anemia and fatigue freq
table,
      since ID is so predictive
      of fatigue. It trends that way but not in a significant way--
might
      be because of trouble reporting fatigue if experienced it a long
time,
      or too many normal
      subjects, or fatigue as a symptom of many other things;
proc freq data=all_data;
      Title 'Frequency Table of Anemia and Fatigue';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables iron_status * fatigue / CHISQ;
      format iron_status iron_statusfmt. fatigue fatiguefmt.;
run;
      *Now I want to look at if ID without anemia is related to the
importan
      t symptoms sum;
proc freq data=all_data;
      title 'Frequency table of ID without anemia and important
symptoms cutoff';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID_no_anemia * func_iron_def_symp_cutoff / CHISQ;
      format ID_no_anemia ID_no_anemiafmt. func_iron_def_symp_cutoff
      func_iron_def_symp_cutofffmt.;
run;
      *I am now going to run a series of tests to see if ID by abnormal
      TIBC and ferritin correlates
      with any of the other important symptoms by themselves, because
it
```

```
      correlated so well to fatigue.  This can help me see if any of
these
      symptoms would be good to use
      for future analysis, as fatigue is---------it seems that with
      the exception of shortness of breath, which has too few of
subjects,
      fatigue is the best functional
      symptom to use for further analysis;
      *This frequency table is ID and racing thoughts that prevent
sleep-
      no relation;
proc freq data=all_data;
      title 'Frequency table of ID and racing thoughts that prevent
sleep';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID * racing_thoughts / CHISQ;
      format ID IDfmt. racing_thoughts racing_thoughtsfmt.;
run;
      *This frequency table is ID and dizziness--no relation;
proc freq data=all_data;
      title 'Frequency table of ID and dizziness';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID * dizziness / CHISQ;
      format ID IDfmt. dizziness dizzinessfmt.;
run;
      *This frequency table is ID and increased fatigue with more
sleep--no relation;
proc freq data=all_data;
      title 'Frequency table of ID and increaed fatigue with more
sleep';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID * fatigue_with_sleep / CHISQ;
      format ID IDfmt. fatigue_with_sleep fatigue_with_sleepfmt.;
run;
      *This frequency table is ID and headaches--no relation;
proc freq data=all_data;
      title 'Frequency table of ID and headaches';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID * headaches / CHISQ;
      format ID IDfmt. headaches headachesfmt.;
run;
      *IMPORTANT: This frequency table is ID and shortness of breath--
there
      appears to be a relationship
      but there are so few samples that it is really hard to say
anything
      definitive.;
proc freq data=all_data;
      title 'Frequency table of ID and shortness of breath';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables ID * short_breath / CHISQ;
      format ID IDfmt. short_breath short_breathfmt.;
run;
```

```
      *I am now going to look at Shortness of breath with IDF vs noIDF
to
      continue my trend in my results;
proc freq data=all_data;
      title 'Frequency table of IDF and shortness of breath';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables TIBC_Ferritin_fatigue * short_breath / CHISQ;
      format TIBC_ferritin_fatigue TIBC_Ferritin_fatiguefmt.
short_breath short_breathfmt.;
run;
      *I am looking at how dizziness and SOB correlate to biochemical
iron
      status by all measurements;
      *start with dizziness;
proc freq data=all_data;
      title 'dizzy and anemia';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizziness * iron_status / CHISQ;
      format dizziness dizzinessfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'dizzy and ferritin';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizziness * ferritin_cutoff / CHISQ;
      format dizziness dizzinessfmt. ferritin_cutoff
ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title 'dizzy and TIBC';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizziness * TIBC_cutoff / CHISQ;
      format dizziness dizzinessfmt. TIBC_cutoff TIBC_cutofffmt.;
run;
proc freq data=all_data;
      title 'dizzy and ID';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizziness * ID / CHISQ;
      format dizziness dizzinessfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'dizzy and IDNA';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizziness * ID_no_anemia / CHISQ;
      format dizziness dizzinessfmt. ID_no_anemia ID_no_anemiafmt.;
run;
      *now SOB;
proc freq data=all_data;
      title 'SOB and anemia';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables short_breath * iron_status / CHISQ;
      format short_breath short_breathfmt. iron_status iron_statusfmt.;
```

```
run;
proc freq data=all_data;
      title 'SOB and ferritin';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables short_breath * ferritin_cutoff / CHISQ;
      format short_breath short_breathfmt. ferritin_cutoff
ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title 'SOB and TIBC';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables short_breath * TIBC_cutoff / CHISQ;
      format short_breath short_breathfmt. TIBC_cutoff TIBC_cutofffmt.;
run;
proc freq data=all_data;
      title 'SOB and ID';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables short_breath * ID / CHISQ;
      format short_breath short_breathfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'SOB and IDNA';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables short_breath * ID_no_anemia / CHISQ;
      format short_breath short_breathfmt. ID_no_anemia
ID_no_anemiafmt.;
run;
      *now looking at SOB and dizziness (2 select symptoms) together
for all iron values;
proc freq data=all_data;
      title '2 select and anemia';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizzy_SOB_cutoff * iron_status / CHISQ;
      format dizzy_SOB_cutoff dizzy_SOB_cutofffmt. iron_status
iron_statusfmt.;
run;
proc freq data=all_data;
      title '2 select and ferritin';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizzy_SOB_cutoff * ferritin_cutoff / CHISQ;
      format dizzy_SOB_cutoff dizzy_SOB_cutofffmt. ferritin_cutoff
ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title '2 select and TIBC';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizzy_SOB_cutoff * TIBC_cutoff / CHISQ;
      format dizzy_SOB_cutoff dizzy_SOB_cutofffmt. TIBC_cutoff
TIBC_cutofffmt.;
run;
proc freq data=all_data;
```

```
      title '2 select and ID';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizzy_SOB_cutoff * ID / CHISQ;
      format dizzy_SOB_cutoff dizzy_SOB_cutofffmt. ID IDfmt.;
run;
proc freq data=all_data;
      title '2 select and IDNA';
      title2 'ID Symptoms Q5 and biochemical measures';
      title3 'ID symptoms Q5';
      tables dizzy_SOB_cutoff * ID_no_anemia / CHISQ;
      format dizzy_SOB_cutoff dizzy_SOB_cutofffmt. ID_no_anemia
ID_no_anemiafmt.;
run;









*COMBINATION OF BIOCHEMICAL MARKERS AND Q5 SYMPTOMS AND OTHER
ASSOCIATIONS
(note that cognition analysis is in the above section);
*Dizziness, SOB, Headaches;
      *Frequency table of the variable anemia_select_Fe_def_sym_cutoff
-
      numbers in each of the four categories.
      select iron deficiency symptoms (dizziness, shortness breath,
headaches);
proc freq data=no_antidep;
      title 'select iron deficiency symptoms (diz/sob/headaches)
cutoff/anemia-no_antidep';
      title2 'diz/sob/headaches';
      title3 'combo biochem & Q5 and other associations';
      tables anemia_select_Fe_def_sym_cutoff /CHISQ;
      format anemia_select_Fe_def_sym_cutoff
anemia_select_Fe_def_sym_cutofffmt.;
run;
proc freq data=all_data;
      title 'select iron deficiency symptoms (diz/sob/headaches)
cutoff/anemia-all_data';
      title2 'diz/sob/headaches';
      title3 'combo biochem & Q5 and other associations';
      tables anemia_select_Fe_def_sym_cutoff /CHISQ;
      format anemia_select_Fe_def_sym_cutoff
anemia_select_Fe_def_sym_cutofffmt.;
run;
*Fatigue
      *I am now looking at the physical symptoms detailed in survey
questions 9-15.  I will
      first look at how they correlate with anemia in frequency talbes,
and then
```

```
      I will look at anemia+fatigue;
proc freq data=all_data;
      title 'Frequency table of anemia and skin conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * skin / CHISQ;
      format iron_status iron_statusfmt. skin skinfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and nail conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * nails / CHISQ;
      format iron_status iron_statusfmt. nails nailsfmt.;
run;
      *IMPORTANT: this one came up as statistically signficant that
anemic women have more
      hair issues;
proc freq data=all_data;
      title 'Frequency table of anemia and hair conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * hair / CHISQ;
      format iron_status iron_statusfmt. hair hairfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and eye conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * eyes / CHISQ;
      format iron_status iron_statusfmt. eyes eyesfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and temperature control
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * temperature / CHISQ;
      format iron_status iron_statusfmt. temperature temperaturefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and misc conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * misc / CHISQ;
      format iron_status iron_statusfmt. misc miscfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and physical cutoff';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables iron_status * physical_cutoff / CHISQ;
      format iron_status iron_statusfmt. physical_cutoff
physical_cutofffmt.;
run;
      *same physical symptoms test for anemia and fatigue;
      *IMPORTANT: skin comes up as statistically significant with
anemia and
```

```
      fatigue but does
      not come up with just anemia--might be further evidence that the
fatigue
      added on is an important measure of functional ID;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and skin
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * skin / CHISQ;
      format function_def function_deffmt. skin skinfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and nail
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * nails / CHISQ;
      format function_def function_deffmt. nails nailsfmt.;
run;
      *IMPORTANT: this one is still statistically significant;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and hair
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * hair / CHISQ;
      format function_def function_deffmt. hair hairfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and eye
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * eyes / CHISQ;
      format function_def function_deffmt. eyes eyesfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and temperature
control
      conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * temperature / CHISQ;
      format function_def function_deffmt. temperature temperaturefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and misc
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables function_def * misc / CHISQ;
      format function_def function_deffmt. misc miscfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia with fatigue and physical
cutoff';
      title2 'fatigue';
```

```
      title3 'combo biochem & Q5 and other associations';
      tables function_def * physical_cutoff / CHISQ;
      format function_def function_deffmt. physical_cutoff
physical_cutofffmt.;
run;
      *Now I am going to look at all the same physical symptoms and ID
by both
      ferritin and TIBC
      and then ID with fatigue;
      *IMPORTANT: this is TRENDING towards significance;
proc freq data=all_data;
      title 'Frequency table of ID and skin conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * skin / CHISQ;
      format ID IDfmt. skin skinfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and nail conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * nails / CHISQ;
      format ID IDfmt. nails nailsfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and hair conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * hair / CHISQ;
      format ID IDfmt. hair hairfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and eye conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * eyes / CHISQ;
      format ID IDfmt. eyes eyesfmt.;
run;
*IMPORTANT: this came up as statistically significant;
proc freq data=all_data;
      title 'Frequency table of ID and temperature control conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * temperature / CHISQ;
      format ID IDfmt. temperature temperaturefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and misc conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * misc / CHISQ;
      format ID IDfmt. misc miscfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and physical cutoff';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables ID * physical_cutoff / CHISQ;
```

```
      format ID IDfmt. physical_cutoff physical_cutofffmt.;
run;
      *Now I am looking at the same phycial symptoms but with ID and
fatigue;
      *IMPORTANT: this is significant while it was only TRENDING there
without
      fatigue--more
      evidence that fatigue may be an important functional symptom;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and skin conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * skin / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt. skin
skinfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and nail conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * nails / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt. nails
nailsfmt.;
run;
      *IMPORTANT: this is trending towards significant while the
without fatigue
      was not at all;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and hair conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * hair / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt. hair
hairfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and eye conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * eyes / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt. eyes
eyesfmt.;
run;
      *IMPORTANT: this is a significant finding, as it was without
fatigue;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and temperature control
conditions';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * temperature / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt.
temperature
      temperaturefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and misc conditions';
      title2 'fatigue';
```

```
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * misc / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt. misc
miscfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID+fatigue and physical cutoff';
      title2 'fatigue';
      title3 'combo biochem & Q5 and other associations';
      tables TIBC_ferritin_fatigue * physical_cutoff / CHISQ;
      format TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt.
physical_cutoff
      physical_cutofffmt.;
run;
```

```
*BIOCHEMICAL MARKERS AND OTHER ASSOCIATIONS---
WITH OR WITHOUT THE ADDITION OF ID SYMPTOMS
(note that cognition analysis is in the above section);
*diet;
      *frequency table of anemia based on hemoglobin and hematorcrit
      and amount of meat eaten/week;
proc freq data=all_data;
      Tables iron_status * meat_consumption / CHISQ;
      Title 'Meat Consumption and Hb and Hct Cutoff';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
run;
      *frequency table of anemia based on hemoglobin and hematocrit and
      vegetarian/meat eater classification;
proc freq data=all_data;
      Tables iron_status * meat_status / CHISQ;
      Title 'Omnivore or Vegetarian Status to Hb and Hct Cutoff';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
run;
      *I am now looking at diet and how that influences ferritin, TIBC,
hemoglobin
      and hematocrit---
      and there does not appear to be a linear relationship between the
      enhancers sum or inhibitors sum with ferritin, TIBC, hematocrit
or hemoglobin
      measures;
proc corr data=all_data;
      title 'Correlation of ferritin values with consumption of iron
absorption enhancers';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
```

```
      var ferritin;
      with enhancers_sum;
run;
proc corr data=all_data;
      title 'Correlation of ferritin values with consumption of iron
abosorption inhibitors';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var ferritin;
      with inhibitors_sum;
run;
proc corr data=all_data;
      title 'Correlation of TIBC with consumption of iron absorption
enhancers';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var TIBC;
      with enhancers_sum;
run;
proc corr data=all_data;
      title 'Correlation of TIBC with consumption of iron absorption
inhibitors';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var TIBC;
      with inhibitors_sum;
run;
proc corr data=all_data;
      title 'correlation of hemoglobin with consumption of iron
absorption enhancers';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var Hb;
      with enhancers_sum;
run;
proc corr data=all_data;
      title 'correlation of hemoglobin with consumption of iron
absorption inhibitors';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var Hb;
      with inhibitors_sum;
run;
proc corr data=all_data;
      title 'correlation of hematocrit with consumption of iron
absorption enhancers';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var Hct;
      with enhancers_sum;
run;
proc corr data=all_data;
      title 'correlation of hematocrit with consumption of iron
absorption inhibitors';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      var Hct;
      with inhibitors_sum;
```

```
run;
      *now I have broken down each of the inhibitors and enhancers into
cutoff
      categories, and I can
      run frequency tables with them---it looks like only egg and other
      alcohol have people in both extremes.;
      *First I am going to do a frequency table with anemia and all of
the
      enhancers and inhibitors separately;
proc freq data=all_data;
      title 'Frequency table of Anemia and Ascorbic Acid consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * AA_cutoff / CHISQ;
      format iron_status iron_statusfmt. AA_cutoff AA_cutofffmt.;
run;
      *Anemia and meat factor freqency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and Meat Factor consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * MF_cutoff / CHISQ;
      format iron_status iron_statusfmt. MF_cutoff MF_cutofffmt.;
run;
      *Anemia and other alcohol frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and Other Alcohol (not red wine)
consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * OA_cutoff / CHISQ;
      format iron_status iron_statusfmt. OA_cutoff OA_cutofffmt.;
run;
      *Anemia and polyphenol frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and Polyphenol consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * polyphenol_cutoff / CHISQ;
      format iron_status iron_statusfmt. polyphenol_cutoff
polyphenol_cutofffmt.;
run;
      *Anemia and calcium frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and calcium consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * calcium_cutoff / CHISQ;
      format iron_status iron_statusfmt. calcium_cutoff
calcium_cutofffmt.;
run;
      *Anemia and soy frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and soy consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * soy_cutoff / CHISQ;
      format iron_status iron_statusfmt. soy_cutoff soy_cutofffmt.;
```

```
run;
      *Anemia and egg frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and egg consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * egg_cutoff / CHISQ;
      format iron_status iron_statusfmt. egg_cutoff egg_cutofffmt.;
run;
      *Anemia and phytate frequency table;
proc freq data=all_data;
      title 'Frequency table of Anemia and phytate consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * phytate_cutoff / CHISQ;
      format iron_status iron_statusfmt. phytate_cutoff
phytate_cutofffmt.;
run;
      *Now I am going to look at ferritin and all of the
enhancers/inhibitors
      separately---it looks
      like only egg and other alcohol have people in the extremes.;
proc freq data=all_data;
      title 'Frequency table of ferritin and Ascorbic Acid
consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * AA_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. AA_cutoff
AA_cutofffmt.;
run;
      *Ferritin and meat factor freqency table;
proc freq data=all_data;
      title 'Frequency table of Ferritin and Meat Factor consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * MF_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. MF_cutoff
MF_cutofffmt.;
run;
      *Ferritin and other alcohol frequency table;
proc freq data=all_data;
      title 'Frequency table of ferritin and Other Alcohol (not red
wine)
      consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * OA_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. OA_cutoff
OA_cutofffmt.;
run;
      *Ferritin and polyphenol frequency table;
proc freq data=all_data;
      title 'Frequency table of ferritin and Polyphenol consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * polyphenol_cutoff / CHISQ;
```

```
      format ferritin_cutoff ferritin_cutofffmt. polyphenol_cutoff
polyphenol_cutofffmt.;
run;
      *Ferritin and calcium frequency table;
proc freq data=all_data;
      title 'Frequency table of ferritin and calcium consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * calcium_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. calcium_cutoff
calcium_cutofffmt.;
run;
      *Ferritin and soy frequency table;
proc freq data=all_data;
      title 'Frequency table of ferritin and soy consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * soy_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. soy_cutoff
soy_cutofffmt.;
run;
      *Ferritin and egg frequency table;
proc freq data=all_data;
      title 'Frequency table of ferritin and egg consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * egg_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. egg_cutoff
egg_cutofffmt.;
run;
      *Ferritin and pytate frequency table;
proc freq data=all_data;
      title 'Frequency table of Ferritin and phytate consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * phytate_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. phytate_cutoff
phytate_cutofffmt.;
run;
      *Now I am going to look specifically at red wine, coffee, and
tea, as
      these are things that
      people consume every day on an excessive level and do have a
known impact
      on iron absorption.  I am going to look at the cutoffs and make
frequency
      tables.;
      *Starting with Anemia to look at coffee, tea, and red wine
consumption---
      no significant results;
proc freq data=all_data;
      title 'Frequency table of anemia and coffee consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * coffee_cutoff / CHISQ;
      format iron_status iron_statusfmt. coffee_cutoff
coffee_cutofffmt.;
run;
```

```
proc freq data=all_data;
      title 'Frequency table of anemia and tea consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * tea_cutoff / CHISQ;
      format iron_status iron_statusfmt. tea_cutoff tea_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of anemia and red wine consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables iron_status * redwine_cutoff / CHISQ;
      format iron_status iron_statusfmt. redwine_cutoff
redwine_cutofffmt.;
run;
      *Now I am going to do the same analysis of coffee, tea, and red
wine with
      ferritin values
      by cutoff--no significant results;
proc freq data=all_data;
      title 'Frequency table of ferritin and coffee consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * coffee_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. coffee_cutoff
coffee_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ferritin and tea consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * tea_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. tea_cutoff
tea_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ferritin and red wine consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * redwine_cutoff / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. redwine_cutoff
redwine_cutofffmt.;
run;
      *Now I am going to do the same analysis of coffee, tea, and red
wine with
      TIBC values by
      cutoff--no significant results;
proc freq data=all_data;
      title 'Frequency table of TIBC and coffee consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables TIBC_cutoff * coffee_cutoff / CHISQ;
      format TIBC_cutoff TIBC_cutofffmt. coffee_cutoff
coffee_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of TIBC and tea consumption';
      title2 'biochemical markers and diet';
```

```
      title3 'biochemical markers and other associatons';
      tables TIBC_cutoff * tea_cutoff / CHISQ;
      format TIBC_cutoff TIBC_cutofffmt. tea_cutoff tea_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of TIBC and red wine consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables TIBC_cutoff * redwine_cutoff / CHISQ;
      format TIBC_cutoff TIBC_cutofffmt. redwine_cutoff
redwine_cutofffmt.;
run;
      *Now I am going to do the same analysis of coffee, tea, and red
wine with
      ID by TIBC and
      ferritin values by cutoff--No significant results;
proc freq data=all_data;
      title 'Frequency table of ID and coffee consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ID * coffee_cutoff / CHISQ;
      format ID IDfmt. coffee_cutoff coffee_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and tea consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ID * tea_cutoff / CHISQ;
      format ID IDfmt. tea_cutoff tea_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of ID and red wine consumption';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables ID * redwine_cutoff / CHISQ;
      format ID IDfmt. redwine_cutoff redwine_cutofffmt.;
run;
      *Now I am going to look at iron supplementation and the
biochemical measures
      cutoffs;
      *IMPORTANT: none of these are significant, so that might be
something to
      mention
      when discussing iron supplementation in general;
proc freq data=all_data;
      title 'Frequency table of iron supplements and anemia';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * iron_status / CHISQ;
      format supp suppfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of iron supplements and anemia+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * function_def / CHISQ;
      format supp suppfmt. function_def function_deffmt.;
run;
```

```
proc freq data=all_data;
      title 'Frequency table of iron supplements and ID';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * ID / CHISQ;
      format supp suppfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of iron supplements and ID+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * TIBC_ferritin_fatigue / CHISQ;
      format supp suppfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
proc freq data=all_data;
      title 'Frequency table of iron supplements and ferritin';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * ferritin_cutoff / CHISQ;
      format supp suppfmt. ferritin_cutoff ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of iron supplements and TIBC';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables supp * TIBC_cutoff / CHISQ;
      format supp suppfmt. TIBC_cutoff TIBC_cutofffmt.;
run;
      *I am now going to analyze Q28 (symptoms of cravings and food
intolerances) with
      various iron states;
      *Frequency table of anemia and the three cutoffs for Q28;
      *IMPORTANT: trending to significance with anemia and craving but
becomes significant
      when add fatigue;
proc freq data=all_data;
      title 'frequency table of cravings and anemia';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables cravings_cutoff * iron_status / CHISQ;
      format cravings_cutoff cravings_cutofffmt. iron_status
iron_statusfmt.;
run;
proc freq data=all_data;
      title 'frequency table of intolerances and anemia';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables intolerances_cutoff * iron_status / CHISQ;
      format intolerances_cutoff intolerances_cutofffmt. iron_status
iron_statusfmt.;
run;
proc freq data=all_data;
      title 'frequency table of Q28sum and anemia';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables Q28_cutoff * iron_status / CHISQ;
      format Q28_cutoff Q28_cutofffmt. iron_status iron_statusfmt.;
```

```
run;
      *Frequency table of anemia+fatigue and the three cutoffs for Q28;
      *IMPORTANT: anemia and fatigue are statistically significant for
cravings---only
      trending that way without fatigue;
proc freq data=all_data;
      title 'frequency table of cravings and anemia+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables cravings_cutoff * function_def / CHISQ;
      format cravings_cutoff cravings_cutofffmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'frequency table of intolerances and anemia+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables intolerances_cutoff * function_def / CHISQ;
      format intolerances_cutoff intolerances_cutofffmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'frequency table of Q28sum and anemia+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables Q28_cutoff * function_def / CHISQ;
      format Q28_cutoff Q28_cutofffmt. function_def function_deffmt.;
run;
*Frequency table of ID and the three cutoffs for Q28;
proc freq data=all_data;
      title 'frequency table of cravings and ID';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables cravings_cutoff * ID / CHISQ;
      format cravings_cutoff cravings_cutofffmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'frequency table of intolerances and ID';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables intolerances_cutoff * ID / CHISQ;
      format intolerances_cutoff intolerances_cutofffmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'frequency table of Q28sum and ID';
      tables Q28_cutoff * ID / CHISQ;
      format Q28_cutoff Q28_cutofffmt. ID IDfmt.;
run;
*Frequency table of ID+fatigue and the three cutoffs for Q28;
proc freq data=all_data;
      title 'frequency table of cravings and ID+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables cravings_cutoff * TIBC_ferritin_fatigue / CHISQ;
      format cravings_cutoff cravings_cutofffmt. TIBC_ferritin_fatigue
      TIBC_ferritin_fatiguefmt.;
run;
proc freq data=all_data;
```

```
      title 'frequency table of intolerances and ID+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables intolerances_cutoff * TIBC_ferritin_fatigue / CHISQ;
      format intolerances_cutoff intolerances_cutofffmt.
TIBC_ferritin_fatigue
      TIBC_ferritin_fatiguefmt.;
run;
proc freq data=all_data;
      title 'frequency table of Q28sum and ID+fatigue';
      title2 'biochemical markers and diet';
      title3 'biochemical markers and other associatons';
      tables Q28_cutoff * TIBC_ferritin_fatigue / CHISQ;
      format Q28_cutoff Q28_cutofffmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
*BLOOD LOSS;
      *now I am looking at blood donation and iron status.  I am going
to start
      with number of
      times donated blood and various iron states by frequency;
proc freq data=all_data;
      title 'Frequency table of blood donation and anemia';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * iron_status / CHISQ;
      format donation donationfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of blood donation and anemia+fatigue';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * function_def / CHISQ;
      format donation donationfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of blood donation and ferritin cutoff';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * ferritin_cutoff / CHISQ;
      format donation donationfmt. ferritin_cutoff ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of blood donation and TIBC cutoff';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * TIBC_cutoff / CHISQ;
      format donation donationfmt. TIBC_cutoff TIBC_cutofffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of blood donation and ID by ferritin and
TIBC';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * ID / CHISQ;
      format donation donationfmt. ID IDfmt.;
run;
proc freq data=all_data;
```

```
      title 'Frequency table of blood donation and ID+fatigue';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables donation * TIBC_ferritin_fatigue / CHISQ;
      format donation donationfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am going to look at number of times donated blood and
various states of iron
      deficiency by correlation;
proc corr data=all_data;
      title 'correlation of number of times donated blood and
biochemical measures';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      var Q23_TEXT;
      with Hct Hb ferritin TIBC;
run;
      *Now I am going to correlate the recency of blood donation with
iron measures;
      *IMPORTANT: there is a significant positive correlation with
Hematocrit and
      Hemoglobin
      suggesting that the farther away blood donation was the higher
the hemoglobin
      and hematocrit status but the R2 are not great;
proc corr data=all_data;
      title 'correlation of recency of blood donation and biochemical
measures';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      var Q24_TEXT;
      with Hct Hb ferritin TIBC;
run;
      *Now I am going to look at period with iron states---did not
really find anything
      significant here;
      *I am starting with how many days ago the period was to iron
states;
proc corr data=all_data;
      title 'correlation of recency of period and biochemical
measures';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      var Q_49_TEXT;
      with Hct Hb ferritin TIBC;
run;
      *now I am looking at how frequently it occurs in 6 months and
iron states;
proc corr data=all_data;
      title 'correlation of frequency of period and biochemical
measures';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      var Q47;
      with Hct Hb ferritin TIBC;
run;
```

```
      *now I'm looking at type of period flow and iron states by cutoff
in frequency
      tables;
proc freq data=all_data;
      title 'frequency table of type of period flow to anemia';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * iron_status / CHISQ;
      format Q48 Q48fmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'frequency table of type of period flow to anemia+fatigue';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * function_def / CHISQ;
      format Q48 Q48fmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'frequency table of type of period flow to ferritn cutoff';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * ferritin_cutoff / CHISQ;
format Q48 Q48fmt. ferritin_cutoff ferritin_cutofffmt.;
run;
proc freq data=all_data;
      title 'frequency table of type of period flow to TIBC cutoff';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * TIBC_cutoff / CHISQ;
      format Q48 Q48fmt. TIBC_cutoff TIBC_cutofffmt.;
run;
proc freq data=all_data;
      title 'frequency table of type of period flow to ID by ferritin
and TIBC';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * ID / CHISQ;
      format Q48 Q48fmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'frequency table of type of period flow to anemia';
      title2 'biochemical markers and blood loss';
      title3 'biochemical markers and other associatons';
      tables Q48 * TIBC_Ferritin_fatigue / CHISQ;
      format Q48 Q48fmt. TIBC_Ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
*BIOMETRIC DATA
      *Now I am going to look at the biometric data and the iron
measures;
      *now I am looking at BMI and iron measures;
proc freq data=all_data;
      title 'Frequency table of BMI and anemia';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BMI_status * iron_status / CHISQ;
      format BMI_status BMI_statusfmt. iron_status iron_statusfmt.;
run;
```

```
proc freq data=all_data;
      title 'Frequency table of BMI and anemia+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BMI_status * function_def / CHISQ;
      format BMI_status BMI_statusfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of BMI and ID';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BMI_status * ID / CHISQ;
      format BMI_status BMI_statusfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of BMI and ID+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BMI_status * TIBC_ferritin_fatigue / CHISQ;
      format BMI_status BMI_statusfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I am looking at Blood pressure and iron measures;
      *IMPORTANT: significant;
proc freq data=all_data;
      title 'Frequency table of Blood Pressure and anemia';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BP_status * iron_status / CHISQ;
      format BP_status BP_statusfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of Blood Pressure and anemia+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BP_status * function_def / CHISQ;
      format BP_status BP_statusfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of Blood Pressure and ID';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BP_status * ID / CHISQ;
      format BP_status BP_statusfmt. ID IDfmt.;
run;
      *IMPORTANT: significant with fatigue but not without fatigue;
proc freq data=all_data;
      title 'Frequency table of Blood Pressure and ID+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables BP_status * TIBC_ferritin_fatigue / CHISQ;
      format BP_status BP_statusfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I am looking at Percent body fat and iron measures;
proc freq data=all_data;
      title 'Frequency table of Percent body fat and anemia';
      title2 'biochemical markers and biometric data';
```

```
      title3 'biochemical markers and other associatons';
      tables PBF_status * iron_status / CHISQ;
      format PBF_status PBF_statusfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of Percent body fat and anemia+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables PBF_status * function_def / CHISQ;
      format PBF_status PBF_statusfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of Percent body fat and ID';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables PBF_status * ID / CHISQ;
      format PBF_status PBF_statusfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of Percent body fat and ID+fatigue';
      title2 'biochemical markers and biometric data';
      title3 'biochemical markers and other associatons';
      tables PBF_status * TIBC_ferritin_fatigue / CHISQ;
      format PBF_status PBF_statusfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
*MEDICAL CONDITIONS;
      *Now I am going to look at all the characteristics presented in
Q16;
      *Now I am looking at nausea and all the iron measures;
      *IMPORTNAT: nausea had some significance, but they are really
small numbers;
proc freq data=all_data;
      title 'Frequency table of nausea and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables nausea * iron_status / CHISQ;
      format nausea nauseafmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of nausea and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables nausea * function_def / CHISQ;
      format nausea nauseafmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of nausea and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables nausea * ID / CHISQ;
      format nausea nauseafmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of nausea and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables nausea * TIBC_ferritin_fatigue / CHISQ;
```

```
      format nausea nauseafmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at vomitting and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of vomitting and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables vomitting * iron_status / CHISQ;
      format vomitting vomittingfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of vomitting and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables vomitting * function_def / CHISQ;
      format vomitting vomittingfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of vomitting and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables vomitting * ID / CHISQ;
      format vomitting vomittingfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of vomitting and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables vomitting * TIBC_ferritin_fatigue / CHISQ;
      format vomitting vomittingfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at constipation and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of constipation and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables constipation * iron_status / CHISQ;
      format constipation constipationfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of constipation and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables constipation * function_def / CHISQ;
      format constipation constipationfmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of constipation and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables constipation * ID / CHISQ;
      format constipation constipationfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of constipation and ID+fatigue';
```

```
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables constipation * TIBC_ferritin_fatigue / CHISQ;
      format constipation constipationfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at diarrhea and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of diarrhea and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diarrhea * iron_status / CHISQ;
      format diarrhea diarrheafmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diarrhea and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diarrhea * function_def / CHISQ;
      format diarrhea diarrheafmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diarrhea and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diarrhea * ID / CHISQ;
      format diarrhea diarrheafmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diarrhea and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diarrhea * TIBC_ferritin_fatigue / CHISQ;
      format diarrhea diarrheafmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at low blood sugar and all the iron measures;
      *IMPORTANT: this is statistically significant with all anemia;
proc freq data=all_data;
      title 'Frequency table of low blood sugar and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables low_sugar * iron_status / CHISQ;
      format low_sugar low_sugarfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: this is statisically significant with all anemia;
proc freq data=all_data;
      title 'Frequency table of low blood sugar and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables low_sugar * function_def / CHISQ;
      format low_sugar low_sugarfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of low blood sugar and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables low_sugar * ID / CHISQ;
```

```
      format low_sugar low_sugarfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of low blood sugar and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables low_sugar * TIBC_ferritin_fatigue / CHISQ;
      format low_sugar low_sugarfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *now I am looking at Q 17--frequency of bowel movements--with the
iron measures;
proc freq data=all_data;
      title 'Frequency table of BM and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables BM * iron_status / CHISQ;
      format BM BMfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of BM and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables BM * function_def / CHISQ;
      format BM BMfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of BM and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables BM * ID / CHISQ;
      format BM BMfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of BM and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables BM * TIBC_ferritin_fatigue / CHISQ;
      format BM BMfmt. TIBC_ferritin_fatigue TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at diabetes medication and the iron measures;
proc freq data=all_data;
      title 'Frequency table of diabetes and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diabetes * iron_status / CHISQ;
      format diabets diabetesfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diabetes and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diabetes * function_def / CHISQ;
      format diabetes diabetesfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diabetes and ID';
      title2 'biochemical markers and medical conditions';
```

```
      title3 'biochemical markers and other associatons';
      tables diabetes * ID / CHISQ;
      format diabetes diabetesfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of diabetes and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables diabetes * TIBC_ferritin_fatigue / CHISQ;
      format diabetes diabetesfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at GERD medications and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of GERD and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables GERD * iron_status / CHISQ;
      format GERD GERDfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of GERD and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables GERD * function_def / CHISQ;
      format GERD GERDfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of GERD and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables GERD * ID / CHISQ;
      format GERD GERDfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of GERD and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables GERD * TIBC_ferritin_fatigue / CHISQ;
      format GERD GERDfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at cholesterol and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of cholesterol and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables cholesterol * iron_status / CHISQ;
      format cholesterol cholesterolfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of cholesterol and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables cholesterol * function_def / CHISQ;
      format cholesterol cholesterolfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
```

```
      title 'Frequency table of cholesterol and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables cholesterol * ID / CHISQ;
      format cholesterol cholesterolfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of cholesterol and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables cholesterol * TIBC_ferritin_fatigue / CHISQ;
      format cholesterol cholesterolfmt. TIBC_ferritin_fatigue
      TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at high triglycerides and all the iron
measures;
      *IMPORTANT: everything with triglycerides is trending or
significant but with
      really small numbers;
proc freq data=all_data;
      title 'Frequency table of triglycerides and anemia';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables trigly * iron_status / CHISQ;
      format trigly triglyfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of triglycerides and anemia+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables trigly * function_def / CHISQ;
      format trigly triglyfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of triglycerides and ID';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables trigly * ID / CHISQ;
      format trigly triglyfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of triglycerides and ID+fatigue';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables trigly * TIBC_ferritin_fatigue / CHISQ;
      format trigly triglyfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Here I am looking at thyroid function and ID in various
measures;
      *IMPORTANT:This is anemia and thyroid--people with anemia are
more likely
      to have a thyroid
      condition, whether functional or not, but it doesn't seem to be
      impacted if only by ferritin and TIBC.;
proc freq data=all_data;
      title 'Frequency table of anemia and thyroid function';
      title2 'biochemical markers and medical conditions';
```

```
      title3 'biochemical markers and other associatons';
      tables iron_status * thyroid / CHISQ;
      format iron_status iron_statusfmt. thyroid thyroidfmt.;
run;
      *IMPORTANT: This is anemia and fatigue and thyroid--people with
anemia
      are more likely to
      have a thyroid condition, whether functional or not;
proc freq data=all_data;
      title 'Frequency table of Anemia with fatigue and thyroid
function';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables function_def * thyroid / CHISQ;
      format function_def function_deffmt. thyroid thyroidfmt.;
run;
      *Now I am just trying to get the number of subjects that fall
within the ranges
      for ferritin status;
proc freq data=all_data;
      title 'Ferritin_status and thyroid';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables ferritin_status * thyroid / CHISQ;
      format ferritin_status ferritin_statusfmt. thyroid thyroidfmt.;
run;
proc freq data=all_data;
      title 'Ferritin_status and temperature';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables ferritin_status * temperature / CHISQ;
      format ferritin_status ferritin_statusfmt. temperature
temperaturefmt.;
run;
proc freq data=all_data;
      title 'Ferritin cutoff and thyroid';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables ferritin_cutoff * thyroid / CHISQ;
      format ferritin_cutoff ferritin_cutofffmt. thyroid thyroidfmt.;
run;
      *This is ID and thyroid--not related;
proc freq data=all_data;
      title 'Frequency table of ID (by TIBC and Ferritin) and thyroid
function';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables ID * thyroid / CHISQ;
      format ID IDfmt. thyroid thyroidfmt.;
run;
*this is ID and fatigue and thyroid--not related;
proc freq data=all_data;
      title 'Frequency table of ID (by TIBC and Ferritin) and fatigue
with
      thyroid function';
      title2 'biochemical markers and medical conditions';
      title3 'biochemical markers and other associatons';
      tables TIBC_Ferritin_fatigue * thyroid / CHISQ;
```

```
      format TIBC_Ferritin_fatigue TIBC_Ferritin_fatiguefmt. thyroid
thyroidfmt.;
run;
*WEIGHT/EXERCISE/SLEEP;
proc freq data=all_data;
      title 'ferritin and obesity distribution';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables ferritin_status * BMI_status / CHISQ;
      format ferritin_status ferritin_statusfmt. BMI_status
BMI_statusfmt.;
run;
proc plot data = all_data;
      title 'plot of ferritin and BMI';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      plot (ferritin) * (BMI);
run;
      *now I am looking at all the weight change issues in Q30 combined
as a whole
      with the iron measures to see if I should delve into this deeper
or not;
      *Now I am looking at nausea and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of weight change and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_change * iron_status / CHISQ;
      format weight_change weight_changefmt. iron_status
iron_statusfmt.;
run;
      *IMPORTANT: this is very significant even though it is not
without fatigue!;
proc freq data=all_data;
      title 'Frequency table of weight change and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_change * function_def / CHISQ;
      format weight_change weight_changefmt. function_def
function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of weight change and ID';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_change * ID / CHISQ;
      format weight_change weight_changefmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of weight change and ID+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_change * TIBC_ferritin_fatigue / CHISQ;
      format weight_change weight_changefmt. TIBC_ferritin_fatigue
      TIBC_ferritin_fatiguefmt.;
run;
      *Now I am going to look further into Q30 to see where the weight
change issue
```

```
      was that made anemia+fatigue so significant;
      *IMPORTANT: all of the fat gain--everything except 'weight_loss'-
--are significant
      with anemia+fatigue!;
proc freq data=all_data;
      title 'Frequency table of weight loss and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_loss * function_def / CHISQ;
      format weight_loss weight_lossfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of weight gain and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_gain * function_def / CHISQ;
      format weight_gain weight_gainfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of fat gain and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables fat_gain * function_def / CHISQ;
      format fat_gain fat_gainfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of waist fat and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables waist_fat * function_def / CHISQ;
      format waist_fat waist_fatfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of inability to lose weight and
anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables unable_weight_loss * function_def / CHISQ;
      format unable_weight_loss unable_weight_lossfmt. function_def
function_deffmt.;
run;
      *I am now running the weight changes with anemia without fatigue
just to follow
      my reporting style in my results section: ie so I can compare it
to the anemia+fatigue
      results;
proc freq data=all_data;
      title 'Frequency table of weight loss and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_loss * iron_status / CHISQ;
      format weight_loss weight_lossfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of weight gain and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables weight_gain * iron_status / CHISQ;
```

```
      format weight_gain weight_gainfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of fat gain and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables fat_gain * iron_status / CHISQ;
      format fat_gain fat_gainfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of waist fat and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables waist_fat * iron_status / CHISQ;
      format waist_fat waist_fatfmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of inability to lose weight and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables unable_weight_loss * iron_status / CHISQ;
      format unable_weight_loss unable_weight_lossfmt. iron_status
      iron_statusfmt.;
*Now I am trying to get a handle on how many subjects are in the ID
without
            anemia group;
proc freq data=all_data;
      title 'Frequency table of ID no anemia and fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables ID_no_anemia * fatigue / CHISQ;
      format ID_no_anemia ID_no_anemiafmt. fatigue fatiguefmt.;
run;
      *Now I am looking at exerise and all the iron measures;
proc freq data=all_data;
      title 'Frequency table of exercise and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables exercise * iron_status / CHISQ;
      format exercise exercisefmt. iron_status iron_statusfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of exercise and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables exercise * function_def / CHISQ;
      format exercise exercisefmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of exercise and ID';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables exercise * ID / CHISQ;
      format exercise exercisefmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of exercise and ID+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
```

```
      title3 'biochemical markers and other associatons';
      tables exercise * TIBC_ferritin_fatigue / CHISQ;
      format exercise exercisefmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;
      *Now I am looking at sleep and all the iron measures;
      *IMPORTANT: anemia and sleep are significant whether with fatigue
or not!;
proc freq data=all_data;
      title 'Frequency table of sleep and anemia';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables sleep * iron_status / CHISQ;
      format sleep sleepfmt. iron_status iron_statusfmt.;
run;
      *IMPORTANT: anemia and sleep are significant whether with fatigue
or not!;
proc freq data=all_data;
      title 'Frequency table of sleep and anemia+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables sleep * function_def / CHISQ;
      format sleep sleepfmt. function_def function_deffmt.;
run;
proc freq data=all_data;
      title 'Frequency table of sleep and ID';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables sleep * ID / CHISQ;
      format sleep sleepfmt. ID IDfmt.;
run;
proc freq data=all_data;
      title 'Frequency table of sleep and ID+fatigue';
      title2 'biochemical markers and weight/exercise/sleep';
      title3 'biochemical markers and other associatons';
      tables sleep * TIBC_ferritin_fatigue / CHISQ;
      format sleep sleepfmt. TIBC_ferritin_fatigue
TIBC_ferritin_fatiguefmt.;
run;



quit;
```