

Physical, Anthropometric, and Behavioral Profile of Adolescent Male Action Sport Athletes

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Abstract

Currently over 1/3 of adolescents are not completing the recommendations for physical activity and participation on high school sports teams is becoming increasingly competitive and therefore, limited. Little is known about adolescent children who are physically active through means other than school sports including recreational sports. This study explores the anthropometrics, physical abilities, physical activity levels, and personality characteristics of male adolescent action sport athletes in comparison to two age-matched samples: traditional sport athletes and sedentary peers. This study included thirteen males (n=6 action sport athletes, n=5 traditional sport athletes, and n=2 sedentary males) who completed underwater weighing, VO_{2max} , vertical jump, sit and reach tests and also completed an Action Sports Athletes Survey. Action sport athletes demonstrated similar physical performance scores as compared to traditional sport athletes, met the recommendations for physical activity, and reported the highest tendencies towards engaging in risky behaviors. These findings suggest that action sport athletes achieve beneficial amounts of physical activity but may have distinct personality traits that deter them from structured physical activity. Considering the importance of physical activity in adolescence, more research is needed to establish whether facilities like skate-parks and ski areas are safe and constructive locations that will engage adolescent males, who may not be interested in school activities, in healthy behaviors.

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Introduction

Being physically active is an important component of a healthy lifestyle at all ages. Within a lifespan it is generally found that younger people tend to be more active than older people. Establishing a regular habit of physical activity in youth and adolescence is especially important because the amount of physical activity achieved as a youth has been correlated to physical activity achieved later in life. Physical activity levels however, tend to drop off significantly at two time points, first during mid-adolescence and second in young adulthood (Troiano, Berrigan, Dodd, Masse, Tilert, and McDowell, 2008). Research surrounding trends in physical activity have been an actively explored topic in the health field.

Youth Physical Activity

At young ages, previous research show that children are sufficiently active and often meet the national recommendations for physical activity (Beets, Bornstein, Dowda, and Pate, 2011; Troiano, 2008). The current recommendations for physical activity for children are defined as at least 60 total minutes of moderate and vigorous physical activity each day. This physical activity should include several types of activities including aerobic, muscle-strengthening, and bone-strengthening practices on at least 3 days per week (Physical Activity Guidelines, 2011). Children may achieve these recommendations through various forms of activity including both structured and non-structured routines as well as both high and low intensity movements. Benefits from these activities include improved cardiorespiratory and muscular fitness, improved bone health, improved metabolic biomarkers, and can also reduce symptoms of anxiety and depression

(Ortega, Ruiz, Castillo and Sjostrom, 2008, Paridon et.al, 2006, Steele-Johannessen, Anderssen, Kolle, and Andersen, 2009). According to one study, 99% of elementary school age children were able to achieve at least the recommended amount of moderate physical activity suggesting that the school day and play time at home are sufficiently active for most children (Eaton et al., 2012).

Adolescent Physical Activity

Levels of physical activity decline significantly as youth advance through adolescence (Eaton et al., 2012; Nader, Bradley, Houts, Mc Ritchie, and O'Brien, 2008; Pate et al., 2002; Troiano et al., 2008). Compliance rates for youth physical activity guidelines within an adolescent population, grades 9th- 12th, range from 37% to 48% according to self-reported data which means that less than 50% of adolescent youth achieve the level of physical activity deemed to be beneficial to health (Eaton et al., 2012; Butcher, Sallis, Mayer, and Woodruff, 2008). Additionally, some students, 23%, reported achieving no moderate or vigorous physical activity at any time in the past 7 days (Eaton et al., 2012).

Other studies have used accelerometers, as a more subjective approach to measuring physical activity, support the self-reported data and specifically found that on average adolescent males are at least moderately physically active 33-55 minutes per day (Nader et al., 2008). This amount of activity fails to meet recommended threshold for physical activity. This is concerning as previous research suggests an inverse relationship between level of physical activity and age, people achieve less physical activity as they get older (Gordon-Larsen 2004; Nader et al., 2008; Pate et al., 2002). This inverse relationship surfaces after ages 9 to 12 when lifetime physical activity levels typically

peak in males (Findlay, Garner, and Kohen 2009). In addition, Nader and colleagues have found that a low family income, living in the Midwest, being female, and having a higher body mass index percentile are all related to lower levels of physical activity (2008).

Benefits of Physical Activity

Children and adolescents not regularly achieving the recommended amount of physical activity are missing out on the many physical and psychological benefits of exercise. Physical activity is known to have protective effects against components of the metabolic syndrome, a cluster of disorders including Type II diabetes mellitus, hypertension, and elevated triglycerides, and low levels of HDL cholesterol; all of which may be affected in part by physical activity (Fletcher, Balady, Blair, Blumenthal, Caspersen, Chaitman, et al., 1996; McGill, McMahan, Zieske, 2000).

Evidence shows that physical activity in childhood minimizes many markers of metabolic disease including blood pressure, central adiposity, lipid profile, and insulin sensitivity. Multiple modes of physical activity including cardiorespiratory and muscular fitness have provided these protective effects in children and adolescents (Steele-Johannessen, Anderssen, Kalle, and Andersen, 2009). In this study, cardiorespiratory fitness was demonstrated by an exhaustive cycling test while muscular fitness was assessed with various strength tests. Higher scores of aerobic fitness, standing broad jump, sit-ups, and handgrip strength were moderately to strongly correlate with lower systolic blood pressure, waist circumference, insulin resistance, and triglyceride counts and also were correlated to increased levels of HDL-c indicating improvements for metabolic risk in 9-to-15 year olds. The relationship of these variables was not significantly changed when groups were separated into normal weight and overweight

groups suggesting that higher levels of fitness was more important than achieving a lower body weight (Steene-Johannessen et al., 2009).

Adolescents who achieved greater physical activity levels and better fitness may see further benefits in the classroom (Nelson and Gordon-Larsen, 2006; Ruiz, Ortega, Castillo, Martin-Matillas, Kwak, Vicente-Rodriguez, Noriega et al., 2010). Those who claimed to regularly participate in sport scored better in verbal, mathematical, and reasoning ability tests of cognition compared to those who claimed not to participate in any sports. Student athletes are more likely to achieve A's in Math and English and are spend more time on homework. Students whose days consist of mostly sedentary behaviors such as watching multiple hours of television each day are less likely to study and score lower on cardiorespiratory fitness tests (Nelson et al., 2006; Ruiz et al., 2010). Despite some parental concern that physical education and athletics take students away from academic work, it would seem that the productive break from cognitive or academic activity is in fact beneficial.

In addition, participation in sport and physical activity has been related to specific health risk behaviors. Nelson and Gordon-Larsen used data from over 10,000 surveys to monitor adolescent behaviors in violence, substance use, truancy, and sexual risk in relation to physical activity and sedentary behavior clusters (2006). One study arranged students into clustered groups based on their preferred physical activities or sedentary behaviors. A group referred to as skaters and adolescents engaging in sport with their parents were less likely to engage in risks related to sex, cigarette smoking, alcohol, truancy, and seat belt use as compared to adolescents with frequent television or video game patterns.

Physical Activity Adherence

High levels of physical activity in adolescence are important not only because of the immediate benefits and improved future health profiles but also because high levels of adolescent physical activity have been linked to continued high levels of physical activity in adulthood (Gray-Donald, O'Loughlin, Paradise, and Hanley, 2009; Tammelin, Nayha, Hills, and Jarvelin 2003; Telma 2005). One study showed that being active on a daily basis as an adolescent increased the odds of being active as an adult by three times compared to those who were active less than once per week. According to the data collected in that study, a dose of two physical activity bouts per week was sufficient to predict high physical activity levels as adults. Trends related to mode of physical activity suggested consistency; individuals who participated in ball games as adolescents were likely to participate in ball games as adults while those who preferred individual sports as an adolescent were more likely to participate in individual sports as adults (Tammelin et al., 2003). Highly active adults are likely to have been committed to sport for a long period of time as adolescents (Telma et al., 2005). It would appear that adults are most likely to participate in physical activities in which they already have achieved proficient skill and also receive genuine enjoyment from in the past.

Benefits of Healthy Diet

Healthy dietary behaviors are equally important as physical activity in achieving energy balance (Bazzano, 2002). Though the food guide pyramid and other nutrition programs have long been a part of the high school health curriculum, most adolescents are not meeting the current recommended nutrient intakes established by governmental institutions (Healthy People, 2010; Dietary Guidelines for Americans, 2005; Eaton et al.,

2006). Upon entering the adolescence years, both boys and girls significantly reduce their intake of vegetables, green/orange vegetable, and fruit (Larson, Neumark-Sztainer, Hannan, and Story, 2007). Overall prevalence of eating at least 5 fruits/vegetables a day and drinking at least 3 glasses of milk per day was higher in younger adolescents as compared to older adolescents but for both groups, only 20% and 16% of students respectively, had met recommendations (Eaton et al., 2011). Some studies have looked at the effect of physical activity participation on dietary patterns. Taliaferro et al., 2010 found that participation on sports teams was related to increased intake of fruits and vegetables in male athletes compared to non-athletes (2010).

Benefits of Sports Participation

Adolescents who attenuate physical activity levels through team sport participation may receive additional social and health benefits. Sixty-one percent of male athletes achieved the recommended amount of physical activity as compared to only 31% of the general adolescent population (Fox, Barr-Anderson, Neumark-Sztainer, and Wall, 2010). Male athletes are significantly more likely to engage in vigorous physical activity than non-athletes. Vigorous physical activity is of great importance due to its contribution to greater cardiorespiratory fitness and functions (Taliaferro, Rienzo, and Donovan, 2010). Grade point average also increased for every additional team sport affiliation in males (Fox et al., 2010).

Despite these additional benefits, participation rates of sports teams decrease at a similar rate of diminished adolescent physical activity levels. Reasons for leaving sports teams include peaking athletically at an early age, not having time for other activities, being ignored or not getting any one-on-one time with a coach, stressful parental

pressure, rivalries with siblings, and non-presence of friends on the team (Fraser-Thomas and Deakin, 2007). Light and moderate intensity activities have been found to be more sustainable than intense programs (Belanger, Gray-Donald, O'Loughlin, Paradise, & Hanley, 2009). These results suggest that adolescents are not continuing to stay physically active after dropping out of team sports when these are the individuals that often need it most. With childhood obesity and adult cardiovascular disease rates on the rise, researchers are currently searching for intervention and programs that can sustain childhood physical activity levels in all adolescents. One area of physical activity which may offer some relief to the examined issues is extreme or alternative sport. This type of physical activity has gone essentially unnoticed by the research community.

Physical Activity through Action Sport

As defined by the American Heritage Dictionary of the English Language, action sports are activities which are perceived as having a high level of danger or difficulty often involving speed, height, a high level of physical exertion, and/or highly specialized gear or stunts (2011). Both the media and researchers have many pseudonyms for this new branch of sport including adventure, alternative, extreme, gravity, lifestyle, and action, all of which reference a collection of sports which may include but is not exclusive to skateboarding, surfing, BMX riding, BASE jumping, skydiving, SCUBA diving, freestyle skiing, snowboarding, wakeboarding, hang gliding, mountain biking, and rock climbing (Breivik, 2010; Kusz, 2007). All of these sports are based in thrill seeking behaviors and the acquisition of new skills.

Though some action sports like surfing and skateboarding have relatively deeper roots in history, this new genre of sport has emerged only recently in the 1970's and has

been gaining in momentum ever since. Winter action sports took the general public's notice in 1994 when World Cup Snowboarding was introduced and then in 1998 when snowboarding was inducted as a sport in the Nagano Olympics (Torjussen and Bahr, 2006). In the 2002 Salt Lake City Olympics, men's snowboarding halfpipe was the first American sweep of an Olympic event since 1956. After these games, snowboarding experienced a 23% increase in participation in the United States (Thorpe, 2009). According to a recent report produced by SnowSports Industries America, both alpine skiing and snowboarding continue to experience consistent growth with respectively 5.4% and 10.4% growth from 2009 to 2010 reaching 11.5 million and 8.2 million total participants respectively (Transworld Business, 2011). Total participation rates for other action sports include 5.3 million mountain bikers, 7.6 million rock climbers, and 2.8 million wakeboarders. These participation rates rival more traditional sports which claim 9.7 million baseball players, 5.4 million football players, and 16.6 million basketball players and yet receive far less attention (SMGA International, 2010). Reinforcing the concept that action sports is in its infancy, over 56% of the action sports population is under 24 years old (National Ski and Snowboarders Association, 2010).

Snowboarding is physically demanding on the body requiring athletes to have superior anaerobic power, lower body and core strength, coordination, technique, and balance (Platzer, Raschner, Patterson, and Lembert, 2009; Karlsson, 1984). The high intensity, rapid muscular contractions in skiing described by Alvarez-San Emeterio and Gonzalez-Badillo can also be applied to snowboarding and account for high isokinetic strength needs (2010). At an elite level, adolescent athletes report body mass index and body fat percentages which fall into national norms but have greater upper and lower

body strength as well as power (Alvarez-San Emeterio and Gonzalez-Badillo, 2010). Athletes use specific training modules to improve movement skills, balance and coordination, jump height, hang time, and stability all qualities which will lead to elevated performance (Platzzer et al., 2009; Torjussen and Bahr, 2006).

Professional action sport athletes compete in events that are either timed or judged based upon level and style of skills or tricks. Top tier competitive events include World Cup Championships, the Olympics, and national tours such as the X-Games and Dew Tours. Action sport athletes and admirers are a growing fan base and have taken to watching their favorite athletes compete; in 2010, Winter-X Games 15 set a record attendance of 114,200 people, and after watching the Salt Lake City Olympics, over 18 million people reported that they would like to try snowboarding (X-Games Media, 2011; Thorpe, 2009). Major corporate industries such as Pepsi-Cola and Red Bull have started using action sport athletes for branding purposes in hope of attracting the buying power of the 58 million consumers between the ages of 10-24 (Bennett and Lachowetz, 2004).

However, the majority of winter action sport participants are not competing at an elite level or even competing at all. For most, there are no team affiliations, practices to attend, or coaches to assist in skill development suggesting a culture that is far removed from traditional sport (Bennett and Lachowetz, 2004; Breivik, 2010; Thorpe, 2009). The participants in this culture value the free and easy nature of the sports and are intrinsically motivated by fun, pleasure, and impressing their friends. They see themselves as outcasts to athletic community but are extremely focus on honing in on specific skills on the mountain. Athletic qualities are not the only important faucet in this culture. The youth of

this culture are strongly influenced by and enjoy magazines, films, events, fashion, and music which are all specific to the action sport domain (Thorpe, 2009).

The popularity of these new sports within younger generations merits attention from the research community. Though the skill and physical ability demands may not be as demanding in recreational adolescent athletes as they are in elite athletes, does participation in sports such as snowboarding adhere to recommended levels of physical activity which also result in improved physical and behavioral health profiles? What kind of athlete is an action sport athlete? If the culture previously described in research also applies to youth populations, the athletes are less likely to participate on structured sports teams and are more likely to be sedentary outside of the action sport culture.

This research, focuses on the role of action sports in the youth community, may offer support to organizations attempting to stimulate child and adolescent physical activities levels via opportunities for sedentary individuals to try new sports.

The purpose of this quantitative study is to explore various characteristics of adolescent male action sport athletes, specifically those involved in the sport of snowboarding. In the study, both anthropometric and physiological tests are used to compare the athletic ability of these athletes when compared to traditional athletes (e.g. basketball) and sedentary youth. In addition, insight on personality characteristics of these individuals is gained through surveys to further build the profile of an adolescent action sport athlete.

It is hypothesized that action sport athletes will have similar body composition, strength, flexibility, and aerobic capacity scores as compared to traditional sport athletes. Both action sport athletes and traditional athletes are expected to have higher scores on

the previously mentioned tests and will also have lower body fat percentages than age-matched sedentary individuals.

Methods

Design:

This study is a descriptive cross-sectional study. The study compares physical abilities, anthropometric measurements, and behavioral aspects of three samples of adolescents. These samples include snowboarding athletes, basketball players, and sedentary individuals. All data collected in this study are quantitative in nature. All physiological assessments and behavioral surveys were completed in approximately 90-minutes after receiving both consent and assent from guardians and participants, respectively. Consent was sought after a description of the risks and benefits of participation in the study was given. If the potential participant is under 18, consent was granted by a legal parent or guardian and assent was given by the adolescent prior to being enrolled in this study.

Participants:

All participants recruited for this study were male, between the ages of 13-18 years of age, and free of injury or any health conditions that may limit physical activity. Only male athletes were used in order to eliminate any physical gender disparities and because snowboarding is largely a male dominated culture (Thorpe, 2009). All participants were categorized into one of the following populations: snowboard/freeski athlete, basketball player, or sedentary individual. Snowboarding and freeskiing athletes include individuals who participate in action sports at least 8 hours per week, most weeks from November to March, as these are the months that the ski/snowboard facilities are open in Minnesota. These athletes were not currently participating in any formal sports teams or

clubs during the winter season. Basketball players represented the traditional sports culture in the study as basketball is a popular winter sport choice of many adolescent athletes, is commonly offered at most high schools, and also utilizes many of the same large, lower body muscle groups as snowboarding (Green, McGuire, Levenson, and Best, 1998; Platzer, 2005). These individuals were currently affiliated with a school or club basketball team of any competitive level. Sedentary individuals were defined as those who did not engage in at least 60 minutes on at least one day of the week in any kind of physical activity which would increase heart rate and make you breathe hard some of the time (Youth Risk Behavioral Surveillance, 2005).

Potential participants for this study (n=20) were recruited from Minneapolis/St Paul area schools and local ski hills. Three traditional sport athletes and 2 action sport athletes did not show up for their assessments and could not be reached for follow-up and 2 underage basketball players were unable to gain parental consent. Thirteen participants completed assessments: 6 action sport athletes, 5 traditional sport, and 2 sedentary boys. Weight was not taken into consideration for recruitment in any population. This study has been granted approval by the University of Minnesota Institutional Review Board.

Procedures:

Anthropometric

The anthropometric data collected include height, weight, and percent body fat using underwater weighing assessment. Height was measured in meters using a stadiometer. Weight was measured in kilograms using a Tanita scale.

Hydrostatic weighing techniques were used to evaluate percent body fat (Adams and Beam, 2008). This technique required a participant to submerge in a tank of water to

measure underwater weight. The displacement of water was calculated as a function of mass per unit volume and was used to determine body density. Because fat is less dense than water, body density can be used to determine amount of fat mass and fat-free mass. This two-component method is currently recognized as the gold standard in field tests measures of body composition (Adams and Beam, 2008).

Participants were asked to refrain from any vigorous physical exercise in the 12 hours before the assessment and also to avoid using caffeine or tobacco products 8 hours prior to assessments. Participants were instructed to arrive at the laboratory in euhydrated state, 3 hours fasted. Participants wore either spandex or a swimming suit and removed all jewelry before entering the water tank. Upon entering the tank participants removed any air from their swimming suit and wiped away any air bubbles on the skin, trapped within the swimming suit, and within the hair.

Underwater weight was determined using software from Exertec (Body Densitometry Systems). Participants sat on a chair with force transducers which is submerged in the water tank. Participants were instructed to exhaled all possible oxygen from their lungs and submerge the remaining above surface body parts into the water tank. When all air bubbles from exhalation cleared the surface a two recording of weight was noted. Participants were instructed to return to the surface or stop the assessment at any time due to discomfort. This process was completed at least three times or until underwater weight was consistent within 0.08 of a kilogram. The computer software completed the body density and percentage of body fat calculations.

Strength/Power

A vertical jump test using a Vertec apparatus was used to measure strength and power of the lower body (Adams and Beam, 2008). This test uses the vertical displacement of body mass during a jump to measure power. The movement requires hip extension, knee extension, plantar flexion, and recruits many of the lower extremity muscles needed for snowboarding and playing basketball. The Vertec apparatus resembles a volleyball standard having red, white, and blue vanes stacked on a swivel pole at the top of the standard.

Participants warmed up for 3 minutes on a treadmill at a speed of 2.5 mph and a grade of 0%. A demonstration of proper vertical jump form was demonstrated including starting the flat-footed jump standing directly under the standard, using a countermovement action, and reaching with dominant hand to move as many vanes as possible while jumping. The jump, defined as the distance between the furthest point of a fully extended arm and the highest vane displaced, was measured in inches. Three trials were attempted by the participant and the best value was recorded.

Using measures of jump height from the Vertec Vertical Jump is highly correlated ($r=.92$) with peak power measures from a force platform suggesting its strength as a power measure. Test and re-test reliability from previously established research has been high ($r=.93$) when procedures are correctly followed and not modified (Davies and Young, 1984; Glencross, 1966).

Aerobic Capacity

Aerobic capacity was determined using a maximal oxygen consumption test (VO_{2mx}). Maximal oxygen consumption is determined by the body's ability to first transport and second utilizes oxygen as the final electron acceptor for energy metabolism

during aerobic exercise. The respiratory transport of oxygen is measured as pulmonary ventilation (V_E) through a breathing tube. To measure the concentration of oxygen versus carbon dioxide present during ventilation an automated gas analyzer was used to draw samples of the gases and was sent to computer software where the metabolic variables were calculated and displayed during the exercise test (Breeze Suite, Medgraphics).

A modified Bruce protocol test was followed using a treadmill and metabolic cart, (CPX Ultima Gas Exchange System). This protocol consists of seven three min stages of exercise with incremental increases in both speed and grade. Participants were encouraged to wear comfortable clothing such as t-shirts, shorts, and athletic shoes. Before the testing began the participant was briefed on the test procedures and given time to become familiar with the equipment involved. The Borg scale was used to determine rate of perceived exertion. At the end of each stage the participants were asked to physically point to their exertion level on a mobile clip board. Stop criteria for the exercise test was determined by the participant putting both hands on the guard signaling their desire to stop or if the participant's heart rate failed to increase with exercise, a progressive fall in systolic blood pressure, or the participant showed signs of extreme fatigue or dizziness (Paridon, 2006).

The participant was fitted for a face mask and a heart rate monitor (Polar Heart Rate) worn across the chest. The first stage began at a speed of 1.7mph with a grade of 0%. Subsequent 3 minute stages incrementally increased both the speed and grade of the treadmill. The participant's heart rate, rate of perceived exertion, fraction concentration of oxygen (F_{EO_2}) and carbon dioxide (F_{ECO_2}) was constantly monitored. The participant

continued the exercise test to maximal volition. At this point a cool down period was administered and consisted of three minutes walking on the treadmill at a speed of 2mph and a grade of 0%.

Maximal oxygen consumption was established if three criteria are met: 1) a respiratory exchange ratio greater than 1.05, 2) a heart rate within 85% of age predicted maximal heart rate, and 3) a rate of perceived exertion greater than 18 (Adams and Beam, 2008; Paridon, 2006).

Flexibility

The Sit and Reach test is commonly used to assess lower back, hip joint, and hamstring flexibility. It has been moderately correlated to hamstring flexibility (r ranges from .039-0.58) and is highly reliable ($r=0.91$) (Adams and Beam, 2008). The test was performed using a boxlike apparatus with an overhanging scale. The participant was instructed to sit on the floor with legs fully extended, shoeless feet against the box. The participant was then instructed to extend arms forward on top of the scale and by bending at the waist, reach as far forward as possible. The furthest distance in fully extended position which could be held for a full second was marked. Three trials were attempted by the participant and the best value was recorded.

Behavioral Aspects

A survey was used to assess various behaviors including diet, physical activity, and personality. The total survey took participants approximately 25 minutes on average to complete.

Some demographic information was recorded in the beginning of the survey. These demographics included date of birth, grade, race/ethnicity, and gender.

The Project EAT Food Frequency Questionnaire from Project EAT 2 was used to assess habitual dietary patterns. This questionnaire which was developed by a multidisciplinary team, utilizes a Social Cognitive Theory framework as well as insight gained from adolescent focus groups, and has been validated in a randomized population of children age 9-18 (Timlin, Pereira, Story, and Neumark-Sztainer, 2008). Information on meal frequency, food frequency, food availability, and food preferences was obtained from this portion of the survey.

A three day physical activity recall modified from the PALA+Peers Program was used to estimate regular daily physical activity levels (Barr-Anderson, Laska, Veblen-Mortenson, Fairbaksh, Dudovitz, and Story, 2011). The recall included at least one week day and one weekend day to account for differences in daily activity patterns. An example was provided to participants to ensure proper recording of physical activities. The three day physical activity recall has been significantly validated against accelerometer data ($r=0.27-0.46$) and is thought to be a suitable measure for school age children and adolescents (Pate, Ross, Dowda, Trost, and Sirard, 2003).

Zuckerman's sensation seeking scale (1994) was used to explore personality traits which may explain the draw of action sports by some students and the avoidance of others. Sensation seeking defined as "the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such experience," has been positively related to many facets of action sports. Two subscales, thrill/adventure and boredom, of Zuckerman's Sensation Seeking Scale-V were used to assess if these aspects of behavior are present in adolescent

action sport athletes (Zuckerman, 1994). Further, the scales were used to determine if action sport athlete scores are distinguishable from other athletes and non athletes.

Additional insert containing questions about regular skiing and snowboarding behaviors was given to the action sport athletes. Questions asked included: “How many days per week do you ski or snowboard”, “Who do you prefer to ski and snowboard with?”, and “While at the ski-hill, which activities do you participate in and what kind of tricks do you perform?” These questions were asked only to gain a better understanding of their goals and commitment to their sport and were not used in the statistical analysis.

Data Analysis:

Descriptive statistics were calculated for demographic and personal variables including age, grade, ethnicity, height, weight, and percent body fat. Due to the considerably small sample sizes and the non-normal distribution of many variables, comparisons were drawn about the three populations in this study by running the nonparametric test, Kruskal-Wallis on all variables of interest. Significant differences between groups were determined using a multiple comparison test on any variables found to be statistically significant. Statistical Analysis Software (SAS 9.2) programming were used to run all statistics. Statistical significance for this pilot study was determined at p-values < 0.10.

Results

Twelve participants enrolled this study. All twelve were evaluated for body composition, physical abilities, and diet and physical activity behaviors. All participants completed all measurements.

Anthropometrics

Table 1 shows the descriptive statistics for sedentary, action sport, and traditional sport athletes. On average the traditional sport athletes were taller than both sedentary and action sport athletes. Sedentary males were the heaviest and also had the highest BMI. Additionally, sedentary males had the highest percentage of body fat versus lean body mass (17.8%) followed by action sport athletes (14.4%) while traditional sport athletes had the lowest body fat percentage (10.7%).

Physical Abilities

Results from tests of physical abilities are found in Table 2. A trend in lower body strength was found between groups though values were not found to be significant at an alpha of 0.10 likely due to the small sample size. The trained basketball players outperformed their non-trained peers with an average jump of 26.8 inches. Action sport athletes reported comparable but not statistically greater jump scores than the sedentary population ($p=0.11$).

Maximal exertion of the cardiovascular system was tested using a Bruce treadmill protocol. Both action sport and traditional sport athletes had a greater capacity for oxygen than did sedentary males (traditional: $61.96 \pm 5.45 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$; action: $54.6 \pm 5.54 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$; sedentary: $40.1 \pm 6.79 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$; $p < 0.05$). Traditional athletes achieved the highest cardiovascular fitness average of 62.0 ml/kg/min and outperformed action sport athletes' cardiovascular average of 54.6 ml/kg/min. All participants in the study met the maximal oxygen consumption criteria established in the protocol by achieving a respiratory exchange ratio greater than 1.05 and a heart exceeding 85% of their heart rate reserve.

Flexibility did not seem to be a differentiating attribute of physical ability in this study as no difference in flexibility between any of the three groups was found ($p = 0.90$)

Physical Activity

Presented in table 3, the amount of physical activity was stratified into moderate physical activity (MET's: 3-6), vigorous physical activity (MET's: <6), and total moderate and vigorous physical activity. All participants reported sustaining similar amounts of moderate physical activity throughout the week ranging between actively pursuing $\frac{3}{4}$ of a 30 minute bout to $1\frac{1}{2}$ of a 30 minute bout ($p = 0.50$). Action sport athletes reported the greatest amount of vigorous physical activity (3.4 bouts) followed by traditional sport athletes (2.1 bouts). Sedentary males reported almost no vigorous physical activity with only 0.17 30- minute bout per day. When combined, action sport athletes achieved the greatest amount of physical activity (action: 4.2 ± 1.73 bouts; traditional: 3.3 ± 1.01 bouts; sedentary: 1.6 ± 0.59 bouts).

Dietary Intake

Meal frequency

Participants were asked questions about how frequently they consumed major meals, snacks, and fast food. All participants reported eating lunch every day. Most participants also reported eating dinner every day. Breakfast consumption was less consistent. A regular breakfast consumption was lower on average in both action sport and traditional sport athletes who admitted to missing breakfast more than twice per week ($p = 0.28$). All groups reported eating snacks at least more than once per day with the athletes snacking

most often throughout the day. All three groups also claimed to eat fast food on occasion throughout the week though traditional athletes stopped for fast food most frequently ($p=0.16$).

Self Efficacy for Healthy Eating

All three groups of adolescent boys reported to have a high availability of healthy foods stocked in their home environments. Self-efficacy for eating these healthy foods was evaluated independently by variable on the degree of confidence (on a rising scale of 1-6) of each participant to eat at least two servings of fruit per day, three servings per day of vegetables, three servings per day of whole grains, and of limiting soda intake to one can per day or less. While all three groups felt mostly confident in their ability to consume an adequate amount of fruits, vegetables, and grains; action sport athletes were less confident than other groups in their ability to limit soda consumption to one can per day ($p = 0.10$).

Values

Participants were asked to rate how much they value healthy eating, exercise, academics, and sports performance. There were no statistically significant group differences found but several trends did emerge. Action sport athletes assigned the highest values to exercise behaviors ($m=3.7$) as compared to traditional sport athletes and sedentary males ($m=3.0$; $m=3.0$). Sports performance however, was valued most by traditional sport athletes ($m= 4.0$), to a lesser extent by action sport athletes ($m= 3.7$), and least by sedentary males ($m=3.0$). The same trend was found for the value of eating healthy foods

(traditional: 3.8; action: 3.2; sedentary: 2.5). All groups placed a high value of academic performance (traditional: 4.0; action: 3.7; sedentary: 4.0).

Sensation Seeking

Two subscales of Zuckerman's Sensation Seeking Scale, thrill and adventure seeking and boredom were evaluated. The overall mean score for sensation seeking was 11.5 points. While not statistically significant, group mean differences were found: action sport athletes had a total sensation seeking mean of 13.3 (SE = 1.51) and a thrill and adventure seeking mean of 8.6 (SE = 0.82) which trended towards significance. A second pattern arose for the boredom scale where sedentary males and action sport athletes had the largest scores (sedentary: 5.0; action: 4.7) and almost doubles the traditional sport athletes average (m=2.8).

Skiing and Snowboarding Behaviors

Table 4 shows the results of the skiing and snowboarding behaviors survey insert taken by only the action sports athletes. All action sport athletes indicated skiing or snowboarding more than once per week over the course of the winter season (November – March). Athletes reported engaging in different styles of skiing/snowboarding including freestyle, simple tricks, and aerial tricks while none of the athletes participated in any racing activities. All athletes preferred to ski/snowboard with friends, 2 enjoyed skiing alone, 1 skied/snowboarded with other unknown skiers/snowboarders from the local ski hill, and 1 participant reported regularly skiing with family.

Discussion

This pilot study represents the first known effort to measure the behaviors, physical abilities, and body composition of adolescent action sport athletes compared to their peers who participate in a more traditional mainstream American sports and peers who are sedentary. Previous studies have assessed the sociological culture of extreme sports such as skiing and snowboarding but none have assessed the effect of such sports on the youth population, the population who has been most aroused by this new genre of sport.

The main findings of this study show that action sport athletes more closely resembled traditional sport athletes than sedentary age matched peers in physical abilities. Both sets of athletes possessed greater cardiorespiratory fitness and lower body strength than sedentary boys of the same age. Though society often believes that young skiers and snowboarders follow a rebellious mold, action sport athletes ranked academic and athletic performance of equal or higher valued when compared to traditional sport athletes. Still, the unique personality traits and sometimes socially abnormal behaviors of the action sport athletes seen in adults also seem to be present during adolescence. In terms of sensation seeking and risk, action sport athletes scored the highest for the total adventure and thrill seeking behaviors reflecting that this group of athletes is more open to participating riskier situations than their peers.

Cardiovascular Fitness

The primary finding of this study revealed new evidence about the cardiovascular fitness of young winter sport athletes. Previously, other studies have assessed the biomechanics and physical characteristics of elite snow sport athletes (Alvarez-San Emeterio and Gonzalez-Badillo, 2010; Turnbull, Keogh, and Kilding, 2011). A strong

cardiovascular system is crucial to the performance needs of these athletes and draws from both the aerobic and anaerobic systems. Most runs down the hill last a few minutes at most, holding and engaging muscles slightly squatted position causing muscles to fatigue. At the end of each ski run the athletes are allowed to rest while returning to the top of the mountain via the chairlift or other mechanism giving the oxidative system a chance to recover. The aerobic component becomes the dominate system later in the day when skiers have been active for several hours, depleting the body of phosphocreatine and glycogen stores which are relied on during anaerobic activity. The aerobic system is further challenged as many adolescent skiers and snowboarders in the park terrain area forgo the chairlift to walk up mountain to their desired feature, saving time and earning more attempts at a stunt or trick.

In the current study, both action sport athletes and traditional athletes demonstrated high levels of cardiovascular fitness and greater oxidative capacity scores than the sedentary group. The cardiorespiratory fitness scores of both athletic groups were higher than norms for adolescent males, scoring in the superior category of the widely used FITNESSGRAM evaluation. Both athletic groups scored well above the 42.1 ml/kg/min level established by Ortega et al. which is the oxidative capacity determined to be of a low metabolic risk (2008). The sedentary group's score reflects a greater risk early for cardiovascular and metabolic disease. Anaerobic power was not measured in the current study but should be evaluated in future studies of adolescent recreational athletes.

Strength

A second marker of ski and snowboard abilities is increased lower body strength. Increased muscular strength allows athletes to have greater control and more forceful muscular contractions resulting in greater athletic performance. Both sports utilize the plyometric countermovement jump, in the form of shooting the ball in basketball or in preparing to take off of a jump on a snowboard. Due to this similar pattern of muscle recruitment, it is not surprising that the action sport and basketball athletes did not record significantly jump performances in the vertical jump test.

The 24.7 in average vertical jump achieved by the action sport athletes is comparable to other adolescent winter sport athletes. Alvarez-San Emeterio and Gonzalez-Badillo assessed the physical abilities of adolescent alpine skiers and found that males had an average vertical jump of 13.6 in, though in this protocol athletes were not able to use arm swing the counter movement (2010). This difference in protocol, adding the arm swing to the countermovement, increases the jump height and mostly likely accounts for the difference between the two winter sport groups.

Flexibility

The third physical ability assessed in this study was flexibility. Differences in flexibility between the athletic groups and the sedentary males were expected but no differences were found. An increase in flexibility was expected in the action sport athletes because of the many on snow movements that require rotation and unique body contortion. Many tricks performed in the park involve complex spins requiring the athlete to twist at the core. Greater flexibility of the core muscles would lead to greater spin. Other tricks involve grabbing the base of the snowboard/skies in various awkward

positions forcing the athletes to contort into any number of awkward positions. Since no differences were seen, it is possible that the athletes in this study may not be aware of the benefits of flexibility in their sport and lack guidance from a coach who might suggest integrating stretching in the practice sessions.

Greater flexibility of the basketball players was expected, though none was found. This was surprising since a period of stretching has long been a normal practice in high school sport training and should have resulted in superior the flexibility.

Body Composition

Over the last several decades, the alarming increase in childhood and adolescent obesity has been well documented (Eaton, 2012). Physical activity through recreational sports may be a fun and non-competitive method of improving body composition as shown by the current study. No significant differences between groups were found for body mass index or percent body but a trend was observed. On average, sedentary males had 3% greater body fat than action sport athletes and 7% more body traditional sport athletes. The trend for body mass index followed suit, an average BMI of 23.6 for sedentary males compared with 22.6 for action sport athletes and 20.9 for traditional sport athletes. All three groups' average BMI scores were within a healthy range that is thought to be protective against future obesity (Steene-Johannessen et al., 2009).

Although the two athletic groups were expected to display similar physical profiles, the sedentary group was expected to report significantly larger body fat percentage and BMI scores. The large standard deviation of the sedentary group's scores suggests that large weight differences within the sedentary group may account for the more desirable scores.

The literature contains little anthropometric data for adolescent skiers and snowboarders. The average body fat percentage for male Alpine racers ranges from 8-11% which is similar to the results of the current study (Alvarex-San Emeterio, 2010). The adolescent Alpine skiers in the Alvarex-San Emeterio study reported a slightly lower average BMI of 21.3 compared to the average BMI of action sport athletes of 22.6. The skiers in the Alvarex-San Emeterio competed at a national level and so their elite level training could be expected to lower both BMI and body fat percentage scores.

Physical Activity

The healthy body composition of the participants in this study may have been influenced by their levels of daily physical activity. All three groups reported getting at least some physical activity throughout the week and all groups met the Healthy People 2010 goals for moderate physical activity (Pate et. al, 2002). Basketball and action sport athletes met and superseded the recommendation for 20 minutes a day of vigorous physical achieving 2.1 and 3.4 30-minute bouts of vigorous physical activity, respectively. The participants in this study are achieving more physical activity than the national average. Eaton et al. found that only 59% of high school males regularly get enough exercise to increase their heart rate and cause heavy breathing (2012). In another study, Pate et al. found that a majority of high school males (79.6%) meet the recommendations for physical activity however only 4.6% meet the standard for vigorous physical activity (2002). Action sport athletes reported spending on average 7 hours a day of vigorous physical activity on the ski hill. While these athletes may actually achieve these vigorous intensities while snowboarding or skiing at certain points during the day it is more likely these periods of intensity lasted under 10 minutes sporadically throughout

the day. Previous studies have also shown a tendency for young people over estimate their physical activity in self reported assessments (Pate, 2002). Skiing and snowboarding is most often considered a moderate intensity sport with intensities of 4-7 MET's recorded in other studies.

Still, the long hours of intermittent activity demonstrate that skiing and snowboarding athletes are achieving more than enough physical activity to benefit from the regular exercise. If the self reported levels of physical activity are truly being met, these action sport athletes may have a decreased risk of metabolic disease, depression, anxiety, and obesity (Oretga, 2008).

Previous research has shown that adolescent males who regularly participate in physical activity even twice a week have an increased tendency towards maintaining an active lifestyle as adults. The protective effects of physical activity already noted in this study will become more critical as these adolescent males enter adulthood. Tammelin et al. has suggested adults are more likely to sustain outdoor recreational activities much like ones in the current study (2003). The participants of this study may be even more likely to adhere to their sports as adults as they have already formed a bond to the sport which is not dependent on parents or coaches.

Risk and Sensation Seeking

Forming an understanding of factors that attract young athletes to more extreme and uncontrolled action sports instead of participating in school sanctioned sports was a key focus of the current study. Psychologists have been working to understand how differences in personality may influence whether an individual will be physically active and further, if traits of their personality may affect which sport that individual will

choose. Participants of sports considered to be extreme are often marked as high sensation seekers, a disposition to constantly seek out new experiences despite any physical or social risks that may accompany the experience. The results of this study show that action sport athletes in this study match this profile, scoring high in both evaluated subscales: thrill and adventure seeking and boredom. Sedentary males scored slightly lower though the difference is more pronounced in the thrill and adventure seeking. This study shows that adolescent action sport athletes appear to be more prone to seeking sensational behaviors than are non-active adolescents or other school sport athletes.

Scoring highest in adventure and thrill seeking reinforces the need for new experiences, possibly in the form of attempting new trick as all participants reported spending significant amounts of time in the terrain park area of the hill. Guskowska found similar results when he compared sensation seeking behaviors of extreme sport athletes (including people who participate in parachuting, wakeboarding, snowboarding, scuba diving, and skiing) to a non-sport control group using the same Sensation Seeking Scale (2010). Males involved in high risk sports demonstrated higher scores on all but one subscale (intellectual stimulation) which was not used in the current study.

Guskowska found in his study that the greatest disparity between high risk athletes and non-athletes was thrill and adventure seeking, the same result found in the current study. It is this part of sensation seeking that describes a person's readiness to take on difficult physical challenges while accepting and even enjoying the increasing risk involved in the challenge. This reflects the skier and snowboarder's desire for bigger jumps and more speed despite the increasing probability of ending up in cast by the close of the day.

Action sport athletes also recorded the highest marks on average on the boredom scale. This may reflect disfavor with the same routine and a need for a constantly changing environment.

While sensation seeking in extreme sports is viewed as a socially acceptable behavior, other less socially acceptable behaviors such as cigarette smoking and sexual risk takers also tend to score high on Zuckerman's Sensation Seeking Scale. This may explain some of the delinquency behaviors often associated with skiing and snowboarding youth. One study however, found contrary evidence in adolescent children. Nelson and Gordon-Larson surveyed several groups of adolescents including high volumes television viewers, skateboarders and bikers, school activity participants, recreation center users, and athletes (2011). They found that the skater group was less likely than television viewers, school activists, and recreation center users to engage in risky behaviors including having sexual intercourse, smoking, drinking alcohol, and using drugs. The study also reported that engaging in 5 or more bouts of physical activity per week, was associated with positive health outcomes, higher self-esteem, and higher academic performance.

A second relevant study conducted by Levenson assessed the difference between members of a drug treatment facility and rock climbers (1990). The members of the drug treatment facility scored higher in a disinhibition subscale and also on the boredom subscale while rock climbers demonstrated greater thrill and adventure seeking scores. This study therefore distinguishes that there is a difference between engaging in extreme physical challenges and antisocial behaviors. While this study was conducted in an adult population it seems likely that the trends would emerge in an adolescent population as

well. Perhaps engagement in action during adolescence serves as an appropriate outlet for sensation seeking for a population of children that would otherwise become attracted to less acceptable risk behaviors. Open access to facilities such as skate parks or park terrain areas on ski hills which can offer both extreme physical challenge and a safe environment are crucial. These facilities should be open during after school hours and on weekends when students not active in extracurricular school based activities are most likely to commit delinquency behaviors.

The sedentary males also scored high on the boredom subscale of Zuckerman's Sensation Seeking Scale. Perhaps this is due to their lack of regular physical activity or hobbies in their after school life.

Self Efficacy of Eating Behaviors

Consuming a healthy diet for proper growth and development is vital during the adolescent years and so the influence of sport-type on adolescent eating behaviors was assessed. Few differences in eating patterns were seen among the three groups. All participants in the study reported eating lunch and dinner daily and only 2 participants reported eating breakfast less than 5 days a week. The daily lunch routine may reflect the controlled nature of the school day and the hour long period set aside for lunch at all Minnesota high schools. The regular occurrence of other meals is higher than what has been observed in other studies (Eaton, 2012).

Confidence to adhere to the dietary recommendations for fruit, vegetable, and whole grains was very high for participants of this study compared to the dietary intakes reported by adolescent males in other studies. Larson et al. found that adolescent males are not meeting the average daily intake of fruits and vegetables proposed by the Healthy

People 2010 guidelines (2007). Action sport athletes and traditional sport athletes were more confident in achieving the dietary recommendations for fruit than were sedentary males. All groups in the current study showed the least confidence to increase their vegetable intake to 3 vegetables servings per day which is consistent with other studies (Culter, 2009; Larson, 2007). It would appear participation in neither structured nor recreational sport had significant effect on dietary eating. The consistency between groups of the dietary patterns within this study may be due to the lack of diversity in the population as all participants were recruited from the middle class suburbs of Minnesota metropolitan areas. All participants would be offered the same lunchtime selections at school and are likely to eat a dinner prepared by a parent or guardian.

One area that did trend toward a difference however was confidence to limit soda consumption to only one can per day. Action sport athletes lacked the confidence of the other groups on this matter suggesting a higher level of soda and possibly caffeine consumption. This may warrant further investigation as companies like Red Bull and Mountain Dew aim their marketing strategies towards this action sport population by sponsoring major events and athletes, handing out free “swag” and sample beverages promoting higher energy levels for higher thrills.

Academics

Finally, when asked to rate the importance of the role of academics, all participants indicated that school and academics were very important. While action sport athletes did rank academic importance lower than traditional athletes and sedentary males the scores were still high overall. This finding agrees with previous literature which

suggests that regular physical activity supports academic interest and boosts grade point averages (Fox, 2010).

The high value given to academics by the action sport athletes may have come as a surprise to those who believe the rebellious stereotype assigned to young extreme sport athletes. Holly Thorpe, a researcher who has studied the social identity of snowboarders over the past decade, has found that they are embodied by a “who cares” attitude, a group striving to be viewed as different and “cool” to the outside world (2009). The interaction between this subculture’s unique attitude and their desire to excel in their academic community has not yet been addressed by the research community and should be pursued in future research.

Strengths and Limitations

These findings offer several strengths to the literature of adolescent participation in action sports. This was the first known study representing the recreational athletes of this growing population rather than the few who make it to the elite level making the results more generalizable at the local community level. The purpose of the study was not to establish enhanced training methods or but rather was to determine what benefits action offers to typical young students and whether the impact of this new subculture is positive or negative overall. In addressing multiple factors of body composition, physical abilities, behaviors, and personality it is apparent that the sports of skiing and snowboarding have had a positive effect on both the health and socialization of this group of athletes. Skiers and snowboarders are within a healthy range for BMI, have a low body fat percentage, achieve the recommended amount of both moderate and vigorous physical activity for children, possess a fitness level protective of metabolic diseases, believe they

can maintain a healthy diet, and hold academics in high esteem. This positive profile has previously been seen in young athletic populations yet this study also separates this group of athletes from other in it risk favoring tendencies in sport.

A second strength of the current study was the use of two age matched control groups. Comparing the action sport athletes to two previously studied groups, adolescent school based athletes and sedentary youth, make the distinctions between assessments very clear. For example, in the assessment of physical abilities we see that the traditional athletes still yield the highest scores; most likely due to the regular training routines created by an adult coach or mentor, the action sport athletes clearly outperform the participants in the sedentary group.

The small sample size of study was the biggest limiting factor. The sedentary group was comprised of only two individuals and the standard errors of the group were disproportionately high. The physiological testing of this study used highly specialized equipment and required participants to travel to the testing center. Many interested study candidates were under the legal driving age or may not have had a method of getting to the testing center, preventing their participation in the study. The difficulty of recruiting this population for the pilot study has been noted and a recruitment strategy will be revisited before the study is expanded.

Information pertaining to physical activity, risk, and self-efficacy of dietary behaviors was collected via self-reported surveys providing another limitation of this study. Participants may have had difficulty remembering behaviors completed several days prior and may have embellished reporting on factors they deemed positive. Future

research should include subjective measures of behavior, such as accelerometers to measure physical activity and food diary to account for eating behaviors.

Conclusion

In summary, adolescent action sport males were found comparable to traditional school sport athletes in body composition, physical traits such as lower body strength and cardiovascular fitness as also in the amount of time spent being physically active. Action sports athletes demonstrate a distinct personality which may leave them susceptible to risky behaviors for the sake of the thrill. The findings indicate a need for facilities where young risk males, who are for whatever reason uninterested in school sponsored sports, can be physically active and safely challenge their physical abilities amongst their peers. Important areas of future research include further personality research potentially further distinguishing this population from their peers, an objective measure of physical activity during the winter season to confirm physical activity levels, and an assessment of antisocial behaviors such as truancy or marijuana use to further understand the sensation seeking personality during adolescence.

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Table 1 Adolescent Males Stratified by Athletic Type ¹			
<i>Variable</i>	Sedentary (<i>n</i> = 2)	Action Sport (<i>n</i> = 6)	Traditional Sport (<i>n</i> = 5)
Age (year)	17.5 ± 02.12	16.6 ± 0.67	17.3 ± 0.72
Grade (Level)	11.0 ± 0.41	10.4 ± 0.89	11.0 ± 0
Weight (lbs)	158.5 ± 57.27	151.2 ± 23.49	155.3 ± 23.68
Height (in)	68.5 ± 1.41	68.6 ± 1.72	72.3 ± 4.95
Body Mass Index (kg/m ²)	23.6 ± 7.56	22.7 ± 3.7	20.9 ± 1.12
Body Fat (%) ²	17.8 ± 2.12	14.4 ± 6.84	10.7 ± 1.31

¹-Data = Point estimates ± standard deviation

²-Body fat as measured by underwater weighing

<i>Variable</i>	Sedentary (<i>n</i> = 2)	Action Sport (<i>n</i> = 6)	Traditional Sport (<i>n</i> = 5)	H value	<i>X</i> ²	<i>P</i> value
Flexibility (cm) ²	34 ± 0.00	33.3 ± 9.79 ^a	34.6 ± 3.70	0.2	2	0.90
Strength (in) ³	19 ± 0.00	24.7 ± 3.89 ^a	26.8 ± 3.32	4.5	2	0.10 ^{*†}
VO ₂ max (ml·kg ⁻¹ ·min ⁻¹) ⁴	40.1 ± 6.79	54.6 ± 5.54	61.96 ± 5.45	7.6	2	0.022 [†]

¹- Point estimates ± standard deviations and Kruskal-Wallis chi-squared values, degrees of freedom, and p values are reported. Significant differences (Kruskal-Wallis Multiple Comparisons) as follows: * significant difference between Action Sport and Traditional Sport Groups; † critical difference between Action Sport and Sedentary groups; ‡ significant difference between tradition Sport and Sedentary groups. ² Flexibility as measured by Sit and Reach Test (Balke, 2001)

³-Strength as measured by Vertec Vertical Jump Test (Balke, 2001)

⁴-Maximal Oxygen Consumption as measured by Bruce Treadmill Protocol (Parison, 2006)

Table 3:
Physical Activity, Dietary, and Psychosocial Behaviors of Adolescent Males ¹

<i>Variable</i>	Sedentary (<i>N</i> = 2)	Action Sport (<i>N</i> = 6)	Traditional Sport (<i>N</i> = 5)	H value	χ^2	<i>P</i> value
<i>Physical Activity</i> (Number of 30 min bouts /day) ²						
Moderate Physical Activity	1.4 ± 0.59	0.8 ± 1.40	1.2 ± 1.14	1.4	2	0.50
Vigorous Physical Activity	0.2 ± 0.00	3.4 ± 2.52	2.1 ± 0.42	4.5	2	0.10 [†]
Total MVPA ³	1.6 ± 0.59	4.2 ± 1.73	3.3 ± 1.01	4.4	2	0.11
<i>Dietary Intake</i>						
Breakfast Frequency ⁴	7.0 ± 0.00	4.4 ± 1.96	4.8 ± 3.01	2.5	2	0.28
Lunch Frequency ⁴	7.0 ± 0.00	7.0 ± 0.00	7.0 ± 0.00	0.0	2	1.00
Dinner Frequency ⁴	7.0 ± 0.00	6.8 ± 0.61	7.0 ± 0.00	1.2	2	0.56
Fast Food Frequency ⁴	1.5 ± 0.00	1.3 ± 0.61	2.3 ± 1.09	3.7	2	0.16
Snack Frequency ⁴	1.8 ± 1.06	2.4 ± 2.04	2.5 ± 0.00	0.9	2	0.62
<i>Self-efficacy to adhere to daily dietary recommendations</i>						
Fruit Intake ⁵	4.5 ± 0.71	5.0 ± 1.26	5.0 ± 1.73	3.5	2	0.17
Vegetable Intake ⁵	4.0 ± 0.00	4.0 ± 1.67	4.2 ± 1.09	0.3	2	0.87
Whole Grain Intake ⁵	6.0 ± 0.00	6.0 ± 0.00	5.6 ± 0.55	3.3	2	0.19
Soda Intake ⁵	6.0 ± 0.00	4.8 ± 1.17	5.8 ± 0.45	4.6	2	0.10 [†]
Value Exercise ⁶	3.0 ± 0.00	3.7 ± 0.52	3.0 ± 0.71	3.7	2	0.16
Value Health ⁶	2.5 ± 0.71	3.2 ± 0.52	3.8 ± 0.45	3.7	2	0.16
Value Athletic Performance ⁶	3.0 ± 1.41	3.7 ± 0.52	4.0 ± 0.00	2.8	2	0.25
Value Academic Performance ⁶	4.0 ± 0.00	3.7 ± 0.52	4.0 ± 0.00	2.5	2	0.28
Weight Concern ⁷	2.0 ± 1.41	2.7 ± 1.21	3.2 ± 0.45	0.4	2	0.43
Perceived Time Barriers ⁸	2.8 ± 0.09	2.9 ± 0.12	3.0 ± 0.09	2.6	2	0.27
Perceived Healthy Food Availability ⁹	3.2 ± 0.60	2.8 ± 0.38	2.9 ± 0.29	1.5	2	0.46
Healthy Foods Preference ¹⁰	2.1 ± 0.12	2.2 ± 0.14	2.5 ± 0.38	4.3	2	0.12

Boredom susceptibility	5.0 ± 5.66	4.7 ± 0.82	2.8 ± 1.30	3.9	2	0.14
Thrill and adventure seeking	6.5 ± 2.12	8.6 ± 0.82	7.0 ± 2.35	2.6	2	0.27
Total risk (boredom + thrill)	11.5 ± 3.54	13.3 ± 1.51	9.8 ± 2.86	4.1	2	0.13

¹- Point estimates ± standard deviations and Kruskal-Wallis chi-squared values, degrees of freedom, and p values are reported. Significant differences (Kruskal-Wallis Multiple Comparisons) as follows: * significant difference between Action Sport and Traditional Sport Groups; † critical difference between Action Sport and Sedentary groups; † significant difference between tradition Sport and Sedentary groups.

²-Physical activity as measured by 3 Day Physical Activity Recall.

³-MVPA is the combined total of moderate and vigorous physical activity.

⁴-Habitual numbers of meals and snacks eaten during the week (Larson, 2011).

⁵-Confidence to adhere to dietary recommendations on 6 point Likert Scale 1 = not confident, 6 =very confident (Larson, 2011).

⁶-Degree of value placed on each attribute on a 4 point Likert Scale: 1= not at all, 4= very much (Larson, 2011).

⁷-Amount of concern over weight control on a 4 point Likert Scale: 1= not at all, 4= very much (Larson, 2011).

⁸-Perception of not having enough time to eat healthy on a 4 point Likert Scale: 1= does not identify; 4= strongly identifies (Larson, 2011).

⁹-Amount of care about eating healthy foods on a 4 point Likert Scale: 1= not at all; 4= very much (Larson, 2011).

¹⁰-Perception of how often healthy foods are available in the home on a 4 point Likert Scale: 1= never, 4= always (Larson, 2011).

¹¹-Boredom and Thrill Seeking Behaviors rated on a 10 point Sensation Seeking Scale 1= no risk, 10 = high risk (Zuckerman, 2004).

Table 4: Skiing and Snowboarding Behaviors in Adolescent Action Sport Athletes	
	<i>n=6</i> (%)
<i>Snowboarding Frequency</i>	
Once a Season	0 (0%)
Once a Month	0 (0%)
Once a Week	0 (0%)
More Than Once a Week	6 (100%)
<i>Activities Performed</i>	
Freestyle	6 (100%)
Racing	0 (0%)
Tricks	6 (100%)
Aerial Tricks	6 (100%)
Observation	1 (17%)
<i>Social Preference</i>	
By yourself	2 (33%)
With Family	1 (17%)
With Friends	6 (100%)
With others at the resort	1 (17%)