The Impact of Ambient Scent Environment on Residents' Wellness and Their Perception of Interior Environments in Long-Term Care Facilities

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ABSTRACT

The elderly population is continuously growing, and the number of older adults living in an institutional setting has been steadily but slowly increased. Because of a higher chance of having psychological disorders among people living in institutional settings than people living in non-institutional settings, providing a supportive institutional setting to the residents is critical to enhance their wellness. The theory of supportive design suggests healthcare facilities can lower people's stress levels via three conditions (i.e., perceived control, social support, and positive distractions). The present study builds on research on supportive design by investigating the impact of positive distractions and ambient scent environment intervention on nursing home residents' health and wellness. When considering ways to promote wellness, complementary and alternative medicine is another method that has promise. An ambient scent environment, especially, has been widely explored for its impact on people's health status (e.g., physical and psychological health). Therefore, this study conducted a single-blind and placebo-randomized controlled study to investigate impacts of ambient scent environment, as a positive distraction, on residents' depression levels and quality of sleep.

The recruited residents (N=58) were randomly assigned into either the intervention group, which received a 1% dilution of lavender scent for two weeks nearby their bedside, or the placebo group, which received a non-scent for two weeks. Their depression levels were measured by the Geriatric Depression Scale, and their quality of sleep was measured by the Pittsburgh Sleep Quality Index at baseline and follow-up, which was two-weeks from the baseline. In a post-experimental interview, the residents

were also asked three things they liked and wanted to improve in the living environment. Based on the *t*-tests, both intervention and placebo groups had improvement on depression, and only the intervention group had improvement on quality of sleep. However, further regression analyses indicated the intervention had no measurable effect on either depression or quality of sleep. The responses from the open-ended questions support the theory of supportive design in that the residents reported appreciation of and desire for perceived control, social support, and positive distraction in their living environment. Regarding the effectiveness of ambient scent environment, more controlled studies with rigorous methodology and larger samples are needed to build on the findings.

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INTRODUCTION

Background

Staying in the hospital (e.g., hospitalization and rehabilitation), away from people's own familiar living environments, is enough to make them emotionally vulnerable, in addition to their health statuses they are confronted with. The health problems, such as life-threatening illnesses, which bring people into healthcare environments, can be tremendous stressors for them (Davydow, Zatzick, Hough, & Katon, 2013). Even when patients are discharged from an intensive care unit and transferred to rehabilitation centers (e.g., transitional care units and long-term care units), their physical activities may be often limited during the recovery due to physical impairments (e.g., weakened muscles) (Bienvenu et al., 2012; Chaboyer, James, & Kendall, 2005). Therefore, they may undergo anxiety, and even further depression as well as posttraumatic distress disorder (Chaboyer et al., 2005), and eventually, those feelings and symptoms can negatively impact their quality of life (Davydow et al., 2013).

The unfamiliar healthcare environments patients stay in, along with the critical health concerns they have, can make them feel strong emotions, such as being overpowered and intimidated (Chaboyer et al., 2005). This is mainly because residents may often feel a loss of control over the environment. For example, the unfamiliar rooms can limit patients' abilities to express their personality and identity (e.g., by not allowing their personal items) (Blumberg & Devlin, 2006; MacAllister, Bellanti, & Sakallaris, 2016). A tendency to have high noise levels in most healthcare environments and no control over the noise can interfere with patients' amount of sleep and quality as well

(Schweitzer, Gilpin, & Frampton, 2004; Zimring, Joseph, & Choudhary, 2004). In addition, patients frequently undergo sleep disorders during their stay at unfamiliar healthcare environments such as strange scents, uncomfortable beds, and different routines (Buckle, 2014). The lack and poor quality of sleep can be detrimental to psychological wellness, leading to high level of stress, anxiety, and depression (Lytle, Mwatha, & Davis, 2014). Moreover, patients can easily lose their control and feel stressed and disoriented in the majority of healthcare environments with the complex and poor wayfinding systems (Ulrich, Simons, & Miles, 2003).

Besides appropriate clinical treatments to heal patients' critical illnesses, a well-planned healthcare environment can expedite the speed of their recovery (Andrade & Devlin, 2015). Therefore, in the Interior Design field, there is growing evidence showing the relationship between positive impacts of well-designed physical environments on patients' wellbeing, mainly via a higher sense of control, more opportunities for social support, and various positive distractions (Sadatsafavi, Walewski, & Shepley, 2015; Zimring et al., 2004). To be specific, the healthcare facilities can grant patients a sense of control over the environment (e.g., noise, light, personalization, and wayfinding) to reduce their stress levels and empower them (Andrade & Devlin, 2015). The facilities also can accommodate spaces for better communication with patients' families/visitors and staff (e.g., comfort family zones and enhanced acoustic privacy) to foster social supports, which can alleviate patients' stress and anxiety while staying there (Zimring et al., 2004). Furthermore, if the facilities provide them with a variety of positive distractions (e.g., television, reading materials, art, nature, and olfactory stimulation),

focus on the patients' pain and negative emotions will be diverted to those distractions (Andrade & Devlin, 2015).

The impact of physical environments in healthcare facilities on patients' health statuses and recovery rates has also been a popular topic and been steadily explored in the health-related fields. In particular, aromatherapy, as one type of positive distraction in terms of olfactory stimulation, can sooth patients' anxiety levels and improve their sleep quality through a relaxation effect (Buckle, 2014; Sánchez-Vidaña et al., 2017). Its effectiveness on better health outcomes has been continuously investigated by multiple researchers with diverse populations (e.g., healthy or unhealthy people, and different age groups and health statuses) in various settings (e.g., waiting areas and intensive care units), since it was introduced as a clinical treatment in the 20th century (Buckle, 2014). For instance, ambient healthcare environments presenting pleasant aromas are assumed to relieve patients' psychological disturbances, and some research found its efficacy to improve health outcomes (Clarke, 2008; Moeini, Khadibi, Bekhradi, Mahmoudian, & Nazari, 2010; Redd, Manne, Peters, Jacobsen, & Schmidt, 1994).

To sum up, although patients are likely under stress while they stay in healthcare environments, if the environments are well-designed to give them a sense of control, to encourage social support, and to provide positive distractions, patients' psychological disruptions may be decreased. Physical environmental settings in healthcare facilities have been shown to enhance patients' wellness and to facilitate their recovery; therefore, the research about their impacts on positive health outcomes is important.

Statement of the Problem

As mentioned above, there are increasing interest among healthcare designers about the relationship between physical environments at hospitals and their impacts on people (Hamilton & Watkins, 2009; Sadatsafavi et al., 2015). This inclination reflects the current trend which the interior design field has been recently following. The trend is called evidence-based design (EBD), and it has been developed from the foundation of evidence-based medicine (EBM) (Hamilton & Watkins, 2009). Starting from the first studies about relationships between built environments and occupants' health in the 1960s, EBD became popular in the 1980s (Alfonsi, Capolongo, & Buffoli, 2014). In EBD processes such as EBM, evidence plays a critical role during the design decision processes. By applying scientific knowledge and methods, EBD has as its ultimate goal to make the best design decisions (e.g., better healthcare facility design, users' lowered stress levels, improved safety and productivity, reduced waste, and higher sustainability) (Berry, Parker, Coile Jr, & Hamilton, 2004).

However, since the advent of EBD, one big obstacle to this concept is the lack of established theory in interior design (Thomson, 1978; Ulrich, Berry, Quan, & Parish, 2010). Hillier and Leaman (1973) mentioned that because explanatory theories in interior design have been developed by "borrowing" from other fields, including history, behavioral studies, psychology, and sociology, there have been deficiencies requiring some level of adaptation respecting interior space. Although multidisciplinary perspectives can improve research and broaden the scope of the discipline, researchers should keep encouraged theory building specific to the discipline (Clemons & Eckman,

2011). However, until now, the majority of studies in the Interior Design field have not been developed from theoretical frameworks, and those studies usually investigate very selective variables (e.g., the thermal condition, acoustics, lighting, ergonomics, etc.) or very broad ones (e.g., physical environments) (Andrade, Devlin, Pereira, & Lima, 2017).

Another big obstacle to the EBD concept is the lack of methodologically rigorous studies, leading to a low level of evidence (Dijkstra, Pieterse, & Pruyn, 2006; Evans, 2003). Although conducting research about physical environments' impact on people's wellness has been increasing in design fields, there are still many more studies conducted in health-related fields (e.g., medical field) rather than in design fields (e.g., interior design field). These limited attempts in design fields to explore the relationships between environments and wellness are even criticized frequently for a lack of rigor (Evans, 2003; Huisman, Morales, Van Hoof, & Kort, 2012).

According to a review paper on healing environments literature, out of 65 research papers, only eight papers (12.3%) have conducted experimental studies (Huisman et al., 2012). That means most studies have been observational or descriptive studies. That further means, only contemporary phenomena of associations between environments and wellness can be found by these types of studies, while the actual cause and effect of environmental elements on wellness can be discovered through experimental designs. Although the need for feasible randomized experiments to explore the impact of physical environments on health was acknowledged a while ago (Evans, 2003), there are limited experimental studies in the field yet.

Even among the experimental studies, there is still no consensus on the effectiveness of some environmental elements on wellness. For example, a high level of noise can be a stressful factor for patients who are staying at healthcare facilities; therefore, an acoustic absorbing floor material, such as carpet, is preferred to reduce stress levels due to the noise (Ulrich, Lawson, & Martinez, 2003). Floors covered with carpet are also beneficial in terms of minimizing fall injuries and making visitors stay longer because of the welcoming feeling (Harris, 2000). However, carpeted floors can be detrimental to health because carpets may harbor disease virus much longer than hard floors and spread infectious diseases (Zimring et al., 2004).

Ambient environments with pleasant aromas can reduce levels of stress, anxiety, and depression (Lehrner, Marwinski, Lehr, Johren, & Deecke, 2005), increase pain tolerance (Prescott & Wilkie, 2007), and improve quality of sleep (Lytle et al., 2014). However, the positive impacts of aromatherapy have not always been found in studies (Buckle, 2014). Examining aromatherapy's effect on different people in different settings with inconsistent standards, in terms of dosages, durations, and processes, may lead to contrary findings among researchers (Sánchez-Vidaña et al., 2017). Furthermore, relatively more research about aromatherapy has been conducted in hospital settings than in rehabilitation settings (e.g., transitional care unit and long-term care unit). Clearly, there is a gap in recent research about the effectiveness of aromatherapy during rehabilitation. Hence, there is a critical need to investigate the efficacy of aromatherapy in rehabilitation settings.

Significance of the Study

By acknowledging the ongoing problems mentioned above, this study can fill the gaps in previous literature. First of all, this study can enhance the theoretical frameworks in Interior Design by exploring one of the theories in the field, which is the Theory of Supportive Design. Strengthening theory within the field by exploring it in diverse ways is researchers' responsibility for future studies, to enhance the theory and to follow the EBD concept, after recognizing the current problem. The Theory of Supportive Design is a representative theory showing both direct and indirect impacts of built environments in healthcare facilities on users' (i.e., patients, staffs, and visitors) wellness via a sense of control, access to social support, and access to positive distractions (Ulrich, 1991). Albeit the Theory of Supportive Design is originally rooted in Interior Design, only limited attempts have been made to investigate the theory, and the theory has been recently revisited (Andrade & Devlin, 2015; MacAllister et al., 2016; Shepley, 2006). This study, therefore, will be able to fill the gaps in the findings based on the Theory of Supportive Design to follow the EBD concept, by focusing on one of the three elements, which is a positive distraction.

Second, this study can present additional findings on the contemporary effectiveness of ambient scent environment in healthcare environments. Due to the ongoing debates on olfactory stimulation's impact and an absence of well-documented standards for using it, more analyses within diverse settings are undeniably in demand (Sánchez-Vidaña et al., 2017). Because rehabilitation facilities are relatively unexamined settings compared to hospitals to explore the impact of olfactory

stimulation, this study will introduce new and additional implications to the current knowledge. In addition, because most studies about aromatherapy have been conducted in health-related fields (e.g., medical fields) (Buckle, 2014), rather than in design fields, this study can add design perspectives by applying interdisciplinary approaches. In other words, exploring olfactory stimulation in design fields can provide a new angle to the inconclusive implications and fill the current knowledge gaps.

Lastly, the findings to fill the gaps will be credible evidence, since they will be generated in an experimental setting. A lack of credible evidence and rigorous studies has been a concern, especially in design fields, despite a trend of an increasing amount of studies (Dijkstra et al., 2006; Huisman et al., 2012). Experimental studies are regarded as more rigorous studies than observational studies, because observational studies are only able to demonstrate the social phenomena at specific times which cannot be interpreted as causal relationships, whereas results from experimental studies can generate cause and effect relationships (G. M. Sullivan, 2011). As the proposed interventions are tested by an experimental design rather than a descriptive study, the interventions will be examined for their effectiveness on wellness from a design perspective, not just describing the current conditions.

Research Questions

The research questions formulated for this study are:

RQ 1. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' depression in long-term care facilities?

RQ 1.1. Do the different environmental settings (e.g., distance to a ventilation system, square footage, and building), as effect modifiers, affect residents' depression change?

RQ 2. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' perceived quality of sleep in long-term care facilities?

RQ 2.1. Do the different environmental settings (e.g., distance to a ventilation system, square footage, and building), as effect modifiers, affect residents' perceived sleep change?

RQ 3. Overall, how do residents perceive interior environments in long-term care facilities?

Definition of Key Terms

Aromatherapy: The treatment of disorders and diseases using a distinctive or usually pleasant smell" (Lis-Balchin, 1997, p. 324).

Complementary and alternative medicine (CAM): A set of broad healing systems for preventing, diagnosing, and treating diseases, and are not part of conventional medicine (Barnes, Powell-Griner, McFann, & Nahin, 2004; Sánchez-Vidaña et al., 2017).

Evidence-based Design: A process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical

decisions, together with an informed client, about the design of each individual and unique project (Hamilton & Watkins, 2009, p. 9)

Essential oils: The volatile and organic constituents of fragrant plant matters that contribute to the flavor and fragrance (Yim, Ng, Tsang, and Leung, 2009, p. 188).

Motivation: A psychological property that encourages a person's action toward a goal by eliciting and/or sustaining goal-directed behavior (Lohse et al., 2013, p. 170).

Perceived control: The degree of control that people perceive over various environmental features (Lee & Brand, 2010).

Positive distraction: The ability to allow the individual to shift focus from negative foci within the health environment to the more restorative aspects of the non-medical world (Shepley, 2006, p. S34).

Quality of life: A subjective assessment of psychological well-being that is characterized by feelings of satisfaction, contentment, joy, and self-determination (Carter & Van Andel, 2011, p. 25).

Social support: Beneficial psychological and material resources to cope with stress from social networks (Cohen, 2004).

Wayfinding: A strategy used to assist people in successfully navigating a site and reaching their intended destination (Salonen et al., 2013).

Well-Being: A state of successful, satisfying and productive engagement with one's life and the realization of one's full physical, cognitive, and social-emotional potential (Carruthers & Hood, 2007, p. 280) .

Wellness: A state of complete integration of the body, mind, and spirit (Carter & Van Andel, 2011, p. 25).

LITERATURE REVIEW

Introduction

This study is developed based on the theory of supportive design. Among three elements from the theory, the purpose of this study is to focus on the impact of positive distractions (i.e., aromatherapy and jigsaw puzzles) on enhanced wellness. Therefore, this chapter reviews current literature on 1) theory of supportive design; 2) perceived control; 3) social support; 4) positive distraction; and 5) aromatherapy. Throughout this chapter, an overall view of the theory behind positive distractions, and relevant themes and concepts will be discussed.

Theory of Supportive Design

The Theory of Supportive Design (see Figure 1) is helpful for interpreting the needs of patients, visitors, and staff in connection with the physical environments of healthcare facilities, and providing guidelines or strategies for implementing supportive design for the users (Ulrich, 1991). This theory may also be helpful in answering to designers' questions that arise due to gaps in the literature, and in decision making in design solutions that promote wellness (Ulrich, 1991).

The major premise of the Theory of Supportive Design is that "to promote wellness, healthcare facilities should be designed to foster coping with stress" (p. 99), and healthcare environments can minimize stress level and promote wellness via three conditions: 1) a sense of control with respect to physical-social surroundings; 2) access to social support; and 3)access to positive distractions in physical surroundings (Ulrich, 1991). Detrimental effects of stress on wellness for patients and staff are well

documented, and present as a major obstacle to healing (Salonen et al., 2013). In general, patients feel stressed because of two main reasons. One, the experience illness associated with reduced physical capabilities, uncertainty, and painful medical procedures. Two, physical-social environments which are noisy, lack of privacy and social support, and cause all of which have a negative impact on patients' wellness (Ulrich, 1991).

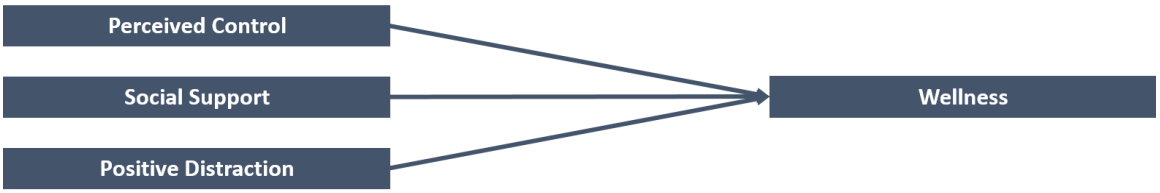


Figure 1. The Theory of Supportive Design and three elements.

Stress threatens patients' psychological, physiological, and behavioral wellness (Ulrich, 1991). A sense of helplessness, feelings of anxiety, and depression can be indicators of the psychological impact of stress, and increased blood pressure, muscle tension, high levels of circulating stress and hormones can be indicators of physiological impacts of stress (Frankenhaeuser, 1980). Verbal outbursts, social withdrawal, passivity, and noncompliance with medication regimes can be also regarded as behavioral impact of stress (Ulrich, 1991).

To help patients coping their stress, the Theory of Supportive Design (Ulrich, 1991) emphasized three main objectives:

1. Health facilities should not raise obstacles to coping with stress, contain features that are in themselves stressors, and thereby add to the total burden of illness.

2. Healthcare environments should be designed to facilitate access or exposure to physical features and social situations that have stress reducing influences.
3. Target groups should include patients, visitors, and healthcare staff. (p.99)

Three Elements from the Theory

As mentioned above, the theory suggests three main conditions of physical environments to cope with stress. First of all, *perceived personal control* is the feeling of control over environmental options, which are beneficial for well-being or stress reduction (Andrade & Devlin, 2015; Lee & Brand, 2005). For example, studies have found higher stress levels when patients are exposed to noisy environments with lack of control over the noise (Inger Hagerman et al., 2005), or to the rooms with a television without personal control (R. S. Ulrich et al., 2003).

The second element is *social support*, and its favorable psychological impact on wellness is well known (Kornblith et al., 2001). Receiving social support from others can reduce stress levels, especially in unfamiliar environments (Bolger & Amarel, 2007). Having sufficient the spaces for social support to accommodate increasing hospital visits by family members can also ameliorate stress (Andrade & Devlin, 2015). Not only for patients, but also for staff, having enough spaces for social support has beneficial impacts on health outcomes (Alfonsi et al., 2014; Salonen et al., 2013).

The third element is *positive distractions,* which are composed of both static stimuli (e.g., reading material, photographs, poster, and paintings of nature) and active stimuli (e.g., music, animals, and people laughing) (Andrade & Devlin, 2015). Based on

distraction theory, the access to nature can bring positive health outcomes by recovering attention depleted by the feeling of pain (Berman, Jonides, & Kaplan, 2008). In addition, Shepley (2006) suggested that art, access to nature, and music can be positive distraction in neonatal intensive care units. However, reactions to stress vary among different groups of occupants. In other words, a distraction can be positive for someone, whereas it can be negative for others. One example is a television in a waiting room. For patients, it can be a positive distraction, reducing their anxieties and stress, while for staff members, who are exposed to the environment all day, it can be a negative distraction (R. S. Ulrich et al., 2003).

The theory has been recently investigated to understand the impact of physical environments at hospitals on occupants' wellness. Andrade and Devlin (2015) tested the theory through an experimental study, using eight different hospitalization scenarios. The scenarios consisted of different combinations of design features in hospital rooms based on the three elements from the Theory of Supportive Design (i.e., perceived control, social support, and positive distraction). The participants rated the design features related to three elements and their perceived stress. The results showed only social support and positive distraction predicted their perceived stress. The authors also found that social support and positive distraction had a mediating effect on the relationship between the number of features in the hospital room and perceived stress.

A year later, the authors postulated that perceived controls did not predict stress levels because the degree of control desirability mediated the relationship between perceived control and stress (Andrade & Devlin, 2016). The authors randomly assigned

the participants into two different hospitalization scenarios: one provides a handheld integrated control, and the other does not. The participants rated perceived control over the environment, desirability of control, and perceived stress. The results confirmed the mediating role of desirability of control by indicating that stress reduction was predicted by perceived control only among people who had a high level of desirability for control, but not among people who had a low level of desirability for control. Even though these two studies were conducted to test the theory holistically, the participants were not actual patients in healthcare environments. Rather, they were students who needed to imagine the given situation.

Table 1

Room Characteristics Affecting Patients Satisfaction

Positive distraction	Perceived control	Social support
TV & Other media	Privacy of the room	Extra seating/bed
View & Window	Health status board	Phone
Light & Sun	Privacy of the bathroom	
Quietness/Noise	Control of temperature and light	
Décor	Control of TV (and other media)	
Pictures & Paintings	Access to staff	
Positive screening	Control of time	
Plants	Personalization	

Note. From Qualities of inpatient hospital rooms: patients' perspectives by Devlin, A. S., Andrade, C. C., & Carvalho, D., 2016, *HERD: Health Environments Research & Design Journal, 9*(3), 190-211.

Therefore, later studies investigated patients' actual perceptions of physical environments. A qualitative study identified the physical environment features in a room that inpatients considered to be perceived control, social support, and positive distraction (Devlin, Andrade, & Carvalho, 2016). Patients listed three characteristics of their rooms affecting their satisfaction with their experience at the hospital. The authors classified the

737 comments provided by patients into three elements from the theory: 245 comments (33.2%) for positive distraction, 165 comments (22.4%) as perceived control, and 44 comments (6.0%) for social support. Further, they classified the comments from each category into eight subcategories of positive distraction, eight subcategories of perceived control, and two subcategories of social support (see Table 1).

The same research team explored the theory holistically, similar to their previous study (see Andrade & Devlin, 2015), but this time they investigated with actual patients, not students. The authors assessed the number of favorable design features in 57 different hospital rooms. The participants rated the physical environments related to the three elements and reported their perceived stress. The results were quite similar to the findings of the previous study (see Andrade & Devlin, 2015). The actual number of design elements was able to predict perceived stress, and only social support and positive distraction had a mediating effect on the relationship between design elements and perceived stress.

In addition, MacAllister et al. (2016) conducted an exploratory study. The study was not actually developed to explore the theory, but was in fact developed to understand the connection between the physical environment and the patients, and their perceptions of healing environment based on the theory of supportive design. Further, the results from patients' perceptions of healing space and experience enhancers are well aligned with the three elements from Ulrich (2002)'s theory. Participants, especially, perceived that healing spaces would provide them with social support, and the comfort and familiarity of home.

The Theory of Supportive Design has been investigated not only via a holistic approach considering all three elements (i.e., perceived control, social support, and positive distraction) but also via approaches focusing on specific elements. Previous literature has often studied the influence of one or two element(s) from the theory on a specific area, such as positive distraction in waiting rooms (Shepley, 2006) or in healing gardens, and for a specific population, such as social support for adolescents (Blumberg & Devlin, 2006). Therefore, sound evidence from previous literature has been provided for Ulrich's three elements.

Therefore, the current literature about three elements of the Theory of Supportive Design and the relevant themes under the three elements will be identified for the following sections (see Figure 2).

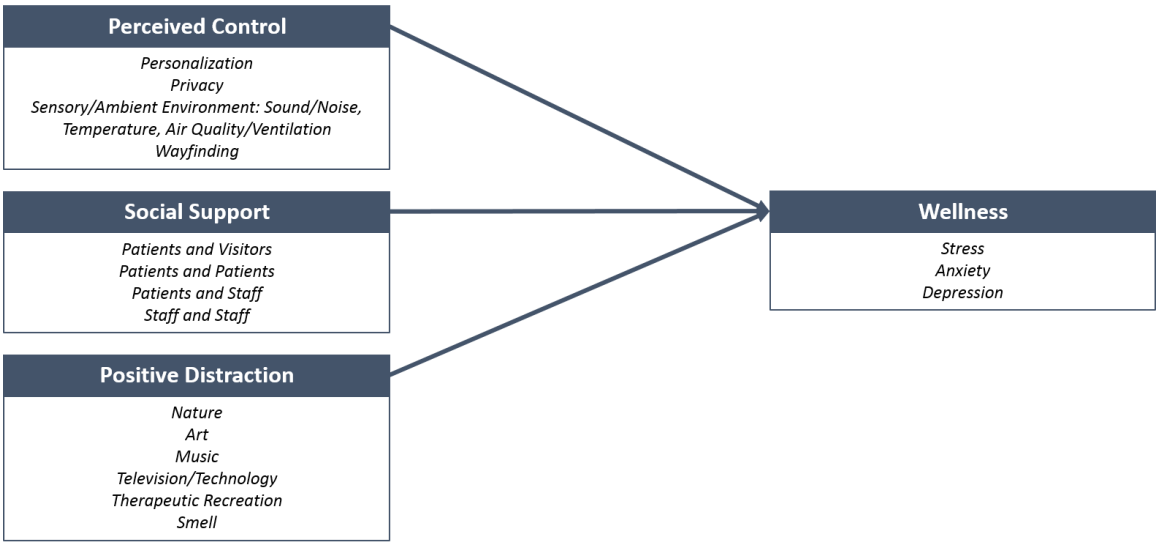


Figure 2. Literature review elements under the Theory of Supportive Design.

Perceived Control in Healthcare Interior Environments

Perceived control, as one of the three elements from the Theory of Supportive Design, refers the degree of control that people perceive over various environmental features (Lee & Brand, 2010). Since the initial study about the relationship between health and perceived control conducted by Seeman and Seeman (1983), following studies have investigated further the impact of control on patients' wellness (Williams, Dawson, & Kristjanson, 2008). For example, Polimeni and Moore (2002) reported an experience of a loss of control among 10-40% of patients, and Moser et al. (2007) found more complications among patients having a high level of anxiety and a low level of control. As stress levels and wellness can be significantly affected by a sense of control, lack of control may lead to negative symptoms (e.g., depression, passivity, elevated blood pressure, and reduced immune system functioning) (Ulrich, 1991).

Hospitals can be commonly considered as unpleasant places to be, mainly because the depersonalizing environment hospitals create may make patients relinquish control over their daily routine behaviors (Taylor, 1979). Hospitals can be also frequently known as places to have major negative contributors, such as lack of privacy, loss of personal control, and noise (Andrade et al., 2017). Therefore, patients may feel a high level of restriction on their behaviors and a lack of control, and this may cause their slow recovery due to increased stress and a sense of helplessness.

In addition to patients, staff also can be negatively influenced by the lack of control over environmental features of hospitals, and may experience stress and burnout, because their work requires high responsibility but provides low control (Shumaker &

Pequegnat, 1989). Moreover, staff are the people who spend most of their time at hospitals to work, so if they are in an unfavorable environment but do not have any control over the environment, their stress may be negatively affected. For these reasons, previous literature has tried to discover the relationships between physical environments and perceived control at hospitals and then to improve the environments by enhancing a sense of control among occupants.

Personalization

During hospitalization, patients are exposed to unfamiliar environments compared with their homes with features, such as uncomfortable atmosphere, unwanted noise, unfamiliar people, and different layouts to bathrooms. The unfamiliar hospital room becomes a patient's territory due to their not guaranteed mobility (Blumberg & Devlin, 2006). These uncomfortable environments can make patients anxious and their recovery hindered. In addition, an extended stay of hospitalization can make patients feel disconnected from their social network (Lewis, Kerridge, & Jorden, 2009). Therefore, letting patients bring their comforting items from home to personalize the environment can provide patients with a sense of control and familiarity (Ulrich & Gilpin, 2003).

This point is also found and emphasized in MacAllister et al. (2016)'s study. Patients perceived healing space as a home-like environment. The authors described how patients were able to feel a sense of connection in an unfamiliar environment through having homelike environments. Throughout interviews with patients, they suggested that bringing some elements from their home can create a healing environment for them. In

addition, personalization was one of the eight subcategories in perceived control which patients identified as design features in their rooms (see Table 1) (Devlin et al., 2016).

Design features can also enhance patients' ability to delineate personal boundaries and to feel private space (Malkin, 1992). Blumberg and Devlin (2006) investigated adolescents' ideal patient room. The authors found that they preferred space with personal belongings (91%) and their own posters (50%) to make personal territory more distinctive and identifiable in the hospital settings. In addition, a clock (88%) was also one of the most popular items for an ideal patient room, and that may be because, as part of control, they need a clock to manage their lives, such as sleep patterns (Blumberg & Devlin, 2006).

Privacy

One of the biggest changes of healthcare environments in the United States, single-occupancy rooms have been widely adopted over the last 20 years (Devlin & Andrade, 2017). Patients in single-occupancy rooms generally have more control over lighting, thermal conditions, air quality (i.e., ventilation), sound, and privacy (Chaudhury, Mahmood, & Valente, 2005). Preference for single-occupancy rooms has been related to several benefits such as better communication with staff, minimization of transfer (due to roommate conflicts), fewer medication errors, decreased infection rates, comfortable inclusion of the family, and better acoustic quality (by lessening roommate noise) (Page, 2004; Zimring et al., 2004).

However, there is disagreement among researchers about the benefits of single-occupancy rooms. For example, a private room is not enough to prevent infection unless proper precautions are met, such as hand washing and correct use of protective gear (Chaudhury et al., 2005; van de Glind, de Roode, & Goossensen, 2007). In terms of safety (i.e., risk of falling), a retrospective comparative study implied that a better room array may be more effective than only a single-occupancy room, since older patients in a single-occupancy room may have a higher risk of falling as a result of their attempts to do things by themselves, such as use bathrooms (Lorenz & Dreher, 2011).

Still, among the aforementioned benefits, patients' higher satisfaction with single-occupancy room is the most consistent (Devlin & Andrade, 2017). According to a review article conducted by Zimring and his colleagues (2004), data from a 2003 nation-wide Press Ganey collected from 1,462 healthcare facilities, implied that patients were consistently more satisfied with "concern for your privacy" in single-occupancy rooms than rooms with a roommate. They also found that, regardless of different patient categories, types of unit, and different age and gender groups, patients more satisfied with privacy in a single-occupancy room. In addition, Jolley (2005) identified the reasons patients prefer single-occupancy rooms to double rooms. The most frequent reason was improved sleep, followed by peace and quiet, and privacy. Another study reported that patients expressed their discomfort, agitation, and even pain when their control over the environments was lacking due to sharing with others (MacAllister et al., 2016). Further, higher satisfaction with their care was found among patients in single-occupancy rooms (Schweitzer et al., 2004).

When studies explore the relationship between privacy and control, the majority focus on the different impacts of single versus double occupancy rooms on privacy and control (van de Glind et al., 2007). Based on those previous findings, it is well known that control over privacy is more likely given to patients in single-occupancy rooms, and patients appreciate the given control over the environment. Single-occupancy rooms provide patients with not only a feeling of less surveillance and of more space, but also a feeling of control over the environmental conditions that fulfills their needs and preferences. However, the more important thing than the type of room is granting patients environmental control (e.g., an adjustable bed, or their own TV) (Chaudhury et al., 2005; Devlin et al., 2016).

Sensory Environment/Ambient Environment

Sound/Noise

As a negative environmental characteristic, a high level of noise can increase patients' perception of pain and usage of pain medication, disturb quality of sleep, and make patients confused and disorientated (Schweitzer et al., 2004). Inpatients frequently complain about distressing noise (Grumet, 1993), and they mention it causes a lack of sleep or a poor quality of sleep (Schweiter et al., 2004). There also have been well-known negative impacts of a high noise level on patients' health outcomes (e.g., disrupting sleep, worsening sleep quality, increasing blood pressure, evaluating heart rate, and reducing patient satisfaction) (Yinnon, Ilan, Tadmor, Altarescu, & Hershko, 1991). Further, the high level of noise can negatively influence not only patients' length of hospital stay, but also staff's burnout symptoms, such as frequent headaches (Grumet, 1993).

To prevent these adverse effects of a high noise level, the World Health Organization encourages noise in healthcare environments not to exceed 35dB in background noise and 40dB in nighttime peaks (Berglund, Lindvall, & Schwela, 1999). However, the finding from an extensive review article summarized that background noise falls between 45dB and 68dB, and peaks noise falls between 85dB and 90dB, which are far higher levels than guideline range (Zimring et al., 2004) . By acknowledging that an increase in 10dB means a doubling in the perceived level (e.g., a 60dB is approximately four times louder than a 40dB), it is apparent that occupants in healthcare environments suffer from the high level of noise.

R. Ulrich et al. (2003) further identified why healthcare environments have such high level of noise. One, there are too many noise sources which are loud (e.g., paging systems, alarms, bedrails moved up/down, telephone, and trolleys). Two, there are hard and sound-reflecting environmental surfaces (i.e., floor, walls, and ceilings). However, accommodating many noise sources and covering spaces with hard surfaces are evitable for hospitals to improve patient care and reduce infectious disease rate. Therefore, design strategies to reduce the noise level or to give patients control over noise can be critical.

One of the popular options among patients is providing single-occupancy rooms. As mentioned earlier in this chapter, single-occupancy rooms have been widely adopted in healthcare environments, and their favorable outcomes on occupants' wellness have been well documented. One of the benefits of single-occupancy rooms is a noise reduction. There is a consistent finding among researchers that single-occupancy rooms have a tendency to have lower noise levels than multi-bed rooms, and the noise in multi-

bed rooms stems from mostly the existence of other patients (e.g., staff caring for other patients, visitors, and patients sounds such as coughing or crying) (Yinnon et al., 1991; Zimring et al., 2004). The higher level of noise due to the presence of other patients can further impact sleep loss. For this fact, patients are more satisfied with a single-occupancy room, mainly because it gives them the opportunity to isolate themselves from the noisy environment.

Another design strategy to reduce noise level is implementing environmental intervention (e.g., installing sound-absorbing ceilings, eliminating/reducing noise sources, or having more single-occupancy rooms). In effect, previous studies have found that a design or environmental intervention is more effective to reduce noise level than an organizational intervention (e.g., staff education, or setting quiet hours) (see Zimring et al., 2004). For example, patients who had stayed in rooms with a sound-absorbing ceiling had a lower incidence of rehospitalization than ones in rooms with a sound-reflecting ceiling (I. Hagerman et al., 2005). In conclusion, for enhancing patients' wellness, design strategies to reduce the noise level as well as to give patients control over the noise sources are important.

Lighting

Lighting (referring to both natural and artificial lighting) is one of the important attributes for creating ambient environments. There are significant differences between natural and artificial light, such as levels of illuminance, uniformity, diffusion of the light, variation of time, color, and amount of ultraviolet radiation (Zilber, 1993). However, both

natural and artificial lighting have beneficial impacts on patients' psychological as well as physiological wellness, directly and indirectly.

To be specific, lighting (i.e., bright light) can result in favorable health outcomes (e.g., treatment for depression, agitation, sleep disorder, and seasonal affective disorders (SAD), and reducing the length of hospital stay) (Zimring et al., 2004). Morning light has beneficial impacts on patients; its twice as effective as evening lighting to treat patients with winter depression (i.e., SAD) (Lewy et al., 1998), as well as significantly reduces agitation among elderly patients with dementia (Lovell, Ancoli-Israel, & Gevirtz, 1995). In addition, patients with severe depression in a bright room had 3.67 days shorter length of stay on average than ones in a dull room in shadow (Beauchemin & Hays, 1996).

Through a randomized prospective study, the amount of natural lighting on patients' psychosocial health, quantity of medication used, and pain medication cost has been found (Walch et al., 2005). Patients were randomly admitted to the bright (rooms on the west side) or the dim (rooms on the east side) side of wards after surgeries. The study, however, did not objectively measure the amount and intensity of lighting. The results indicated that patients in bright rooms reported less perceived stress, less pain, had 22 percent less medication per hour, and 20 percent lower pain medication expenses.

A recent multi-method study, combined interviews and questionnaires, additionally investigated the benefits of daylighting and outdoor views from having better window placement in short-term rehabilitation facilities (Gharaveis, Shepley, & Gaines, 2016). The results from 34 participants demonstrated that daylighting was beneficial for their rehabilitation and that they needed to reposition themselves due to light disturbance

while sleeping. In addition, the participants pointed out that their stress levels, moods, and activities could be significantly affected by the size and location of windows and that they preferred to have direct outdoor views in their rooms.

Creating an environment with abundant lighting is beneficial not only for patients but also for staff. For example, Alimoglu and Donmez (2005) found less stress and higher satisfaction at work among nurses who were exposed to daylight at least three hours a day, and implied that a lack of daylight increased burnout. There is also a study that found a strong association between electric lighting (amount and visual quality of electric lighting) and staff's perception of physical environments at hospitals (Sadatsafavi et al., 2015). On the contrary, poorly designed or maintained lighting that cause glare or flicker, has negative impacts on occupants (Schweitzer et al., 2004). The negative impacts include worsening existing vision problems, more eye fatigue and headaches, and a loss of concentration, especially among the elderly (Arneill & Frasca-Beaulieu, 2003).

A recent study also investigated nurses' perceptions of lighting conditions at medical-surgical hospital units (Hadi, DuBose, & Ryherd, 2016). Based on the survey results from 393 nurses, availability of lighting controls, either switches to turn lights on and off or dimmers, had a strong relationship to satisfaction about the lighting conditions. The results also indicated that overall, the nurses had fewer controls over dimmers than light switches, and they perceived that the most important place to have dimmers were patient bedsides, followed by decentralized nursing stations.

For these reasons, there is less stress for occupants if the environment provides them with choices and the ability to control the physical environments, such as lighting,

temperature, and acoustic conditions (Shepley, 2006). However, what is more important is providing an environment with appropriate conditions. When environmental factors (e.g., amount of lighting and temperature) were appropriate for occupants, they perceived the factors to be under their control and cared less about personal control (Sadatsafavi et al., 2015).

Temperature

Despite the well-known negative impact of thermal stressors on human performance (Hancock, Ross, & Szalma, 2007), there are insufficient studies investigating a relationship between temperature and health outcomes (Schweitzer et al., 2004). For patients, providing thermal comfort has impacts on stabilized psychological status, improved sleep quality and quantity, and reduced length of hospital stay (Hwang, Lin, Cheng, & Chien, 2007). Conversely, patients reported a reduced total sleep time due to frequent wakefulness in too warm environments during the night, and a hard time falling and staying asleep in cold environments (Okamoto-Mizuno, Tsuzuki, & Mizuno, 2005). For staff, the environment providing thermal comfort is associated with higher work performance and productivity, and decreased stress and anxiety (see Salonen et al., 2013).

However, accommodating every single person's thermal comfort zone in a given space is extremely challenging, because there is a huge variation in thermal comfort zones, both physiologically and psychologically, owing to personal preference (ASHRAE, 2010). People may have different thermal comfort zones because of different levels and types of activity, age, and clothing even though they share the same hospital

environment (Hwang et al., 2007). Furthermore, compared to other sensory environments (e.g., light and sound), control over temperature is complicated and difficult to accomplish at healthcare environments, unless there is a completely separate space.

Air Quality/Ventilation

A high level of indoor air quality (IAQ) can be achieved by installing efficient ventilation systems, and can engender favorable health outcomes including lower incidence of respiratory diseases, fewer symptoms of allergies and asthma, lower transmission of infectious diseases, and higher work productivity (see Salonen et al., 2013). Maintaining properly functioning ventilation systems, in particular, is critical for negative pressure rooms to protect patients, staff, and visitors from airborne diseases (see Salonen et al., 2013).

In addition, natural ventilation is economy friendly because it increases energy efficiency (Schweitzer et al., 2004). Furthermore, operable windows let occupants have control over the environment (e.g., ambient smells and breezes) and a feeling of openness to environments. However, there is a disagreement among researchers on natural ventilation. The opponents of natural ventilation argue that hospital-acquired infection rate may be increased by letting outside air pollutants come inside (Schweitzer et al., 2004).

Wayfinding

Wayfinding is defined as “a strategy used to assist people in successfully navigating a site and reaching their intended destination” (Salonen et al., 2013, p. 15).

Occupants, especially outpatients and visitors, are often faced with challenging wayfinding in unfamiliar, complex, and stressful healthcare environments (Carpman & Grant, 2016). They can feel a sense of control over the situations in healthcare environment with successful wayfinding systems (Salonen et al., 2013). On the other hand, they feel a loss of control, making them stressed and disoriented, in poorly designed wayfinding systems (Ulrich, 1991; R. S. Ulrich et al., 2003). Further, wayfinding problems can create financial problems from organizational perspectives by increasing hidden costs (Zimring, 1990).

A poor wayfinding system is a common issue in the majority of healthcare environments, since hospitals contain a great deal of information at a glance. Not only a complicated floor plan, but also inadequate or inconsistent environmental cues (e.g., color and lighting) make poor wayfinding systems in healthcare environments (Brown, Wright, & Brown, 1997; Huisman et al., 2012). Therefore, previous literature has investigated wayfinding systems within a specific group, such as visually impaired patients (Rousek & Hallbeck, 2011), and patients with dementia (Marquardt, 2011; Passini, Pigot, Rainville, & Tétreault, 2000). According to a review article by Devlin (2014), wayfinding systems can be enhanced by plan configuration and manifest cues (e.g., landmarks and signage) as traditional methods. Wayfinding systems can further be improved by the more recent trend of integrating the traditional methods with emerging technologies (e.g., mobile applications, virtual reality, and computational models of wayfinding).

To be specific, clear and easy-to-follow wayfinding maps are required (Huisman et al., 2012), especially orienting maps signifying directions easily (Zimring et al., 2004). Zimring and his colleagues additionally summarized that the quantity of signs has strong associations with wayfinding indices (e.g., travel time, the frequencies of hesitation, the number of times asking directions, and reported stress). Further, the best locations of signs are at or before every major intersection and destination, and the optimal interval between signs is from 4.6 to 7.6m unless key decision points exist along a route. In addition, other environmental cues, such as a different flooring materials, can imply separate zones (Zimring et al., 2004).

Despite those findings, the authors concluded that ideal solutions towards the wayfinding problem are not simple (e.g., better signage or colored lines on the floor) (Zimring et al., 2004). Better solutions would involve establishing integrated systems providing coherent elements (e.g., visible and easy-to-understand signs), clear and consistent directions (e.g., both verbal and documented communication, such as paper, mail-out, and electronic information), and legible physical environments (Carpman & Grant, 2016; Zimring et al., 2004). Healthcare environments should let occupants have a sense of control over finding directions to their destinations, without being stressed, through clear, consistent, and integrated wayfinding systems.

Social Support in Healthcare Interior Environments

As one of the three elements from the Theory of Supportive Design, social support refers to beneficial psychological and material resources to cope with stress from social networks (Cohen, 2004). Further, Uchino (2009) classified social support into

perceived social support, as access to social support, and received social support, as actual social support services and resources. When people are exposed to unfamiliar and stressful environments, such as hospitals, social support from others, as a well-known psychosocial factor, can not only ameliorate stress (Bolger & Amarel, 2007), but also generate positive health outcomes (Uchino, 2009). Social support can also alleviate staff's stress levels and depression symptoms (Park, 2007).

Although the significance of social support is well-documented, there is a lack of research studying social support can be facilitated or hindered by hospital design (Zimring et al., 2004). For outpatients, Sommer and Ross (1958) suggested a long time ago that social interactions were strengthened by environmental factors (e.g., lounges and waiting rooms with cozy and movable furniture which can be arranged to accommodate flexible groups). They also found that social interactions were hindered by side-by-side arranged seating in waiting rooms. Similarly, for inpatients, more recent research has shown that social interaction as well as eating behavior (e.g., amount of food consumed) were enhanced by the flexible arrangement of movable seating in psychiatric wards' and long-term care facilities' dining areas (see Zimring et al., 2004). Not only furniture arrangement but also materials can impact the pattern of social interactions. For example, visitors spent more time with their patients in carpeted rooms than in vinyl-floored rooms (Harris, 2000). Besides hospital visiting regulations, patients can feel a high or low level of social support via physical environments, such as a bedside phone, visual and auditory privacy, comfortable seating, or overnight accommodation (Devlin & Andrade, 2017).

In terms of fostering social supports, different room types (e.g., single/multiple-occupancy rooms) can have their own advantages. Researchers agree on the advantages of different room types, but which room type is better for enhanced social support is still debated. To be specific, single-occupancy rooms are better for accommodating visitors' presence by having more space and furniture than multibed rooms, which more likely to have a lower level of privacy and restricted visiting hours (Chaudhury et al., 2005). As mentioned earlier, patient-satisfaction data from Press Ganey indicated that patients were more satisfied with single-occupancy rooms than those with a roommate, and one of the reasons was "accommodations and comfort for family and visitors" (Zimring et al., 2004). However, there may also be an advantage of double rooms in terms of social support because of the opportunity to have social interaction with a roommate. Larsen, Larsen, and Birkelund (2014) studied patients in two-, three-, or four-bed hospital rooms through a qualitative study and found that patients perceived a loss of privacy and personal control and a high level of noise in shared rooms, but also support from their roommates. Eighteen out of 20 preferred shared rooms if they were not too sick to interact. Rowlands and Noble (2008) also found that patients preferred shared rooms if their health status was well enough to interact, acknowledging the importance of social interaction with other patients. Nonetheless, most studies indicate that roommates can be stressors to each other due to loss of privacy, noise, uncleanliness, unfriendliness, or too many visitors (Chaudhury et al., 2005; Zimring et al., 2004).

Patients and Visitors

It is critical for healthcare environments to have a space to accommodate visitors where they can stay with patients or sleep overnight because it can enhance social support for patients from visitors (Ulrich et al., 2008). In addition, the presence of visitors is also helpful to prevent patients from falling since they can help patients with movements (e.g., getting in and out of bed). However, it has a downside as well. Having the space for visitors may make it hard for staff to take care of their patients, and it may not be possible in some specific facilities, such as a psychiatric unit (Tyson, Lambert, & Beattie, 2002). In addition, some patients may not be eligible to have the space because they already have infectious diseases or are susceptible to infection (Salonen et al., 2013).

As mentioned above, single-occupancy rooms are more likely to enhance social support for patients from visitors (Chaudhury et al., 2005), and the social support which patients receive from their visitors fulfill their emotional needs with therapeutic impacts on their health (Bolger & Amarel, 2007). Patients with critical illnesses, especially, need a space for visitors, and the space should be comfortable for waiting, quiet enough for staying overnight, and accessible to the patients directly (Carpman & Grant, 2016). Another study conducted telephone interviews with 380 discharged patients, and found that they were most satisfied with the large private room with family space, a nice window view, and easy access to bathrooms (Harris, McBride, Ross, & Curtis, 2002). Patients also preferred single-occupancy rooms because the presence of their family members/visitors prevented upsetting other patients, besides the other benefits of private rooms (e.g., higher privacy, reduced noise, and a better quality of sleep) (Kirk, 2002).

Patients and Staff

Having good communication with staff improves patients' health outcomes, such as reduced patients' and families' anxiety and better after care at home (Zimring et al., 2004). Nation-wide survey results also indicate that good communication with staff, as the most significant factor for higher satisfaction, tends to happen more in single-occupancy rooms than rooms with a roommate (Zimring et al., 2004). This may be because single-occupancy rooms create more private environments, whereas, in double rooms, staff become more reluctant to talk with patients about their private issues or information, just in case their roommates may hear the conversation (Kaldenberg, 1999). Therefore, the trend of having more single-occupancy rooms can mitigate the concerns about patients' privacy and confidentiality (Zimring et al., 2004).

In addition to single-occupancy versus double-room designs, decentralized versus centralized nursing stations can affect communication patterns between patients and staff. Specifically, with decentralized nursing stations, nurses can save walking (Sturdavant, 1960) and have more time for caring for patients (Salonen et al., 2013). The increased time for patient care is highly associated with patients' safety and social support from staff. However, decentralized units are not as good for staff's social support, which will be discussed in the next section. Decentralized units make staff have fewer communications among themselves than centralized ones, and the fewer social interactions make them feel detached from their colleagues and disconnected from teamwork (Salonen et al., 2013; Tyson et al., 2002).

Staff

Not only patients but also staff need social support from their colleagues; therefore, the healthcare environment, which is their workplace, should accommodate space for them to relax, refresh themselves, and interact with their colleagues (Joseph, 2006b). Better communication among staff enhances sharing information and team collaboration and fulfills their emotional needs. These beneficial outcomes lead to more effective healthcare service eventually (Joseph, 2006b).

As mentioned above, one well-known physical environment design that affects communication patterns is decentralized versus centralized nursing stations. Centralized stations can help all staff members on the patient care team to engage in open communication and peer monitoring (Bromberg, Bajaj, Kelly, & Redman, 2006). As an advantage, it fosters communication among staff members naturally; therefore, they feel more engaged with each other. On the other hand, decentralized stations can be beneficial to saving walking distance and maintaining better visibility of patients (Joseph, 2006b). As a disadvantage, it brings about fewer communication opportunities among staff; therefore, they feel less social support (Joseph, 2006b; Tyson et al., 2002). This reduced communication opportunity may lead to a sense of isolation, which can negatively impact optimal patient care and work performance (Hendrich et al., 2009).

Positive Distraction in Healthcare Interior Environments

As the third element from the Theory of Supportive Design, positive distraction refers to "the ability to allow the individual to shift focus from negative foci within the health environment to the more restorative aspects of the non-medical world" (Shepley,

2006, p. S34). Positive distraction covers both static stimuli (e.g., reading material, photographs, and representational posters or paintings of nature), and active stimuli (e.g., music, animals, and laughing) (Andrade & Devlin, 2015).

An environment having a moderate degree of positive stimulation (i.e., neither too high nor too low) is the most optimal environment for wellbeing, because, as an environmental design attribute, positive distraction can help restoration from negative effects (Ulrich, 1991). To be specific, patients have a tendency to focus more on their worries, which causes increased stress, especially, in environments providing a lower level of positive stimulations or distractions. The main roles of positive distraction are to lower patient stress and to promote wellness because it evokes positive feelings, makes patient focus on interesting things without being disturbed by stress, and finally prevents worrisome thoughts (Ulrich, 1991). Patients can be distracted by what they see and hear and move their attention from pain and stress to those distractions (Devlin et al., 2016).

Nature

Nature's positive impact on favorable wellness, as a positive distraction has been the most frequently investigated, and therefore is well recognized among researchers. Wilson defined 'biophilia' to refer to human beings' innate emotional connection with other living organisms (as cited in Shepley, 2006, p. s35). Based on this concept, if human beings encounter a lack of opportunity to interact with nature, such as in typical healthcare environments, their biophilic impulses become disrupted. Nature, either real or simulated, alleviates the level of stress within three to five minutes, and its positive impact is not limited only to patients, but also includes other populations (Zimring et al.,

2004). The benefit of nature on human attention and the quality of life has been discovered through Attention Restoration Theory (ART) (Kaplan & Kaplan, 1989). In restorative environments, stressful or negative feelings (e.g., fear and anger) decrease whereas pleasant feelings increase (Zimring et al., 2004). Restoration can be understood as recovery at the physical and psychological levels (e.g., stress, relaxation, and cognitive capacity), and an ideal restorative environment, helping to reduce stress and fatigue, can be created with nature (Devlin & Andrade, 2017).

Nature View

The view conditions are one of the most influential indoor environmental qualities for building occupants, even though they often see at least partially blocked view by other buildings (Devlin & Andrade, 2017). For example, occupants with a panoramic view had more positive impacts on physical and psychological health than those with a view obstructed, either partially or fully, by other buildings (Raanaas, Patil, & Hartig, 2012). A view of nature is, especially, important to reducing stress levels and leading to favorable physiological changes, such as lowering blood pressure (Ulrich, 1991). The initial attempt to discover the impact of nature views on recovery among patients was done a couple of decades ago (Ulrich, 1984). The author found that patients with a window showing a nature view had better emotional status and fewer pain medications than patients seeing a brick wall. In a later study, the same author suggested that lower levels of stress and anxiety, and less medication usage were found among patients having a landscape picture, showing trees and water, than patients with no picture (Ulrich, 1991). The impact of viewing nature has been investigated by other

researchers as well. One randomized prospective study found that less pain was reported during a painful bronchoscopy procedure if patients were assigned to a room with a ceiling with a nature scene and nature sounds, than if patients were assigned to a typical room with a blank ceiling (Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003).

Even virtual nature, such as a stimulation or videotape, has a positive impact on wellness among patients. For example, patients in burn units usually suffer from severe pain; however, after being exposed to a videotape of nature (e.g., forest, flowers, ocean, and waterfalls) during burn dressing changes, some reported significantly less pain and anxiety (Miller, Hickman, & Lemasters, 1992). Another randomized controlled experiment utilized a soundless videotape of nature to investigate its impact on pain among healthy volunteers, not patients (Tse, Ng, Chung, & Wong, 2002). The study found a higher pain threshold and pain tolerance among the volunteers who were exposed to the nature videotape. A different study about viewing nature scenes among blood donors discovered a similar result (R. S. Ulrich et al., 2003). Lower blood pressure and pulse rates were reported among blood donors during the days when a television in a waiting area showed a nature videotape, instead of regular television programs. Another quasi-experimental study showed that dementia patients had fewer agitated aggressive behaviors when a shower bath had a recorded nature sound (e.g., birds and babbling brook) and color pictures (Whall et al., 1997). In addition, lower levels of anxiety and stress were presented among female patients at a cancer center who saw a virtual reality nature walk, showing a forest with bird sounds (Schneider, Prince-Paul, Allen, Silverman, & Talaba, 2004).

Exposure to nature views is beneficial not only for patients, but also for staff. For instance, alertness stayed the same or increased and stress levels stayed the same or decreased among pediatric nurses who were exposed to nature; whereas alertness decreased and stress levels increased among those who had no view or a view not showing nature (Pati, Harvey Jr, & Barach, 2008). Another research conducted pre-post evaluations at intensive care units and found a significant impact of nature views on reduced staff absenteeism and vacancies (Shepley, Gerbi, Watson, Imgrund, & Sagha-Zadeh, 2012).

Healing Gardens

One of the trends healthcare facilities have followed in the 21st century is embracing healing gardens or garden areas within the environments for enhancing therapeutic and restorative qualities (Devlin & Andrade, 2017). The authors mentioned that the increasing adoption of healing gardens in healthcare environments can involve walking, exploring, or even just viewing the gardens. Therefore, not only patients but also staff can feel welcoming emotions, reduce their stress, and improve their health outcomes through the existence of gardens that promote social support and create opportunities to escape from and control over the stressful clinical settings (Marcus & Barnes, 1995; Ulrich, 1991). Indeed, from four hospital garden post-occupancy evaluations, Marcus and Barnes (1995) found that staff visited gardens for pleasant escape from stressful environment. Another post-occupancy study indicated that more positive moods, reduced stress levels, and higher satisfaction with overall care quality were reported when patients and their visitors had access to a hospital garden (Whitehouse et al., 2001). The authors

also pointed out that healing gardens can be extremely beneficial for hospitalized children, since they undergo a stressful experience once admitted, and they perceive gardens as locations for active use and refuges from the stressful situation.

However, simply implementing gardens does not necessarily mean they will be used; therefore, researchers have investigated how to maximize their usage. For instance, proper management of advertisements to encourage using the gardens should be accompanied with the installation (Whitehouse et al., 2001). Providing elements to support a variety of activities can bring different types of users and age groups to the healing gardens (Sherman, Varni, Ulrich, & Malcarne, 2005). Moreover, since poor maintenance decisions or low accessibility lead to lower satisfaction with gardens, proper maintenance and high accessibility should be considered (Davis, 2011). In addition, the use of gardens among staff increased when there was enough shade and quality seating (Pasha, 2013).

Plant

As mentioned earlier, often the views in hospital environments are blocked at least partially because hospitals in urban environments are most likely surrounded by other buildings. In addition, providing nature views from hospital environments is not always easy to achieve, because rooms may be located off interior corridors without windows, or because a buffer against radiation may be required by some types of technology (Devlin & Andrade, 2017). Therefore, another possible option for positive distraction that gives a sense of nature can be having plants in hospital settings. However, placing plants or flowers, both fresh and dried, in hospital rooms may be considered an

inappropriate option in terms of preventing the spread of healthcare-associated infections (Centers for Disease Control and Prevention, 2012).

Despite the above CDC guidelines, researchers have tried to find positive and diverse impacts of having plants in rooms on recovery. For example, patients recovering from surgery were randomly assigned to either a room with flowering and foliage plants or a room without any plants (Park & Mattson, 2008). Patients assigned to a room with plants had significantly fewer painkillers, more positive physiological outcomes (e.g., lower systolic blood pressure and heart rate), higher satisfaction, and lower levels of pain, anxiety, and fatigue than patients assigned to a room without any plants. In another randomized controlled study conducted a year later, the same authors were able to support those findings by finding similar results (Park & Mattson, 2009). They also found from patients' comments that plants brightened the room, lowered their stress, and influenced their higher satisfaction with the quality of care and staff. Moreover, having indoor plants in addition to an already implemented nature view could enhance the subjective wellbeing of patients (Raanaas et al., 2012).

Art and Music

Even though art was introduced to healthcare environments as early as the 14th century (Shepley, 2006), a relatively small amount research has investigated its impact on wellness in healthcare environments (Zimring et al., 2004). The majority of existing findings, in terms of art in healthcare environments, indicates the beneficial impacts on patients' wellness in inpatient rooms as well as waiting areas (Devlin & Andrade, 2017). However, the caveat of utilizing art as a positive distraction is that the genre (e.g.,

modern, abstract, primitive, or representational) should be carefully and deliberately considered and then placed in the setting (Shepley, 2006; Zimring et al., 2004). For example, Carpman and Grant (2016) studied randomly selected inpatients' art preferences, and found that they liked nature images not abstract art. Ulrich and Gilpin (2003) also discovered the same result, that patients recovering from surgery liked more representational arts than abstract arts.

Shepley (2006) interpreted this finding as implying color preference, because the subdued colors of nature are usually used in representational arts, while unexpected color distributions can be frequently found in abstract arts. In effect, there are research findings that saturated colors are preferred among anxious people (Ireland, Warren, & Herringer, 1992), and that people who prefer more stimulation have a tendency to like more abstract arts (Zuckerman, Ulrich, & McLaughlin, 1993). These findings can explain the Shepley's interpretation. Environmental Competence/Press Theory can additionally explain it by suggesting, that once people get stressed, they prefer less challenging environments (Lawton & Eisdorfer, 1973). To be specific, it is humans' natural desire to maintain balance by pursuing less stimulating external environments due to the increased internal emotional stimulation, like stress.

Therefore, Ulrich and Gilpin (2003) suggested guidelines for selecting art for patients, such as characteristics to be avoided (e.g., ambiguity, emotionally negative subjects, etc.), to be encouraged (e.g., warmer season landscapes, openness, etc.), and for figurative arts (e.g., positive facial expressions, people during leisure activities in nature, etc.). However, there is no conclusive agreement on preferences of different art genres.

For instance, as there was no preference for certain art genres among young children, researchers implied that preferences can be formed by previous exposure (McGhee & Dziuban, 1993). On the other hand, a more recent study refuted the result by finding that representational nature art was most preferred among both healthy children (66%) and pediatric patients (60%) (Eisen, Ulrich, Shepley, Varni, & Sherman, 2008). In conclusion, more studies on art and its impact on patients in healthcare environments are needed to enhance the current body of knowledge.

As another popular positive distraction in healthcare environments, music was used for patients in surgery units as early as 1948 in the United States (Schweitzer et al., 2004). Since then, numerous studies have investigated pleasant music's positive impacts on various types of patients' wellness, both physiologically (e.g., lower pain, blood pressure, heart rate and respiratory rate, and faster recovery) and psychologically (e.g., lower stress, depression, and anxiety, and higher satisfaction), in particular when the music is controllable (Salonen et al., 2013).

Several review articles about the impacts of physical environmental settings on humans' wellbeing have summarized well the positive health benefits from music. To be specific, music plays a significant role on mitigating noisy environments in hospitals; therefore, it reduces stress and anxiety levels, heart rates, and the need for anesthesia (Nilsson, 2008). In addition, decreased stress hormones in the blood and perceived pain were reported when surgeries were operated with music (Schweitzer et al., 2004). Lastly, music is beneficial to reducing the amount of painkiller usage and to accelerating recovery among patients who have undergone surgery (Nilsson, Rawal, Uneståhl,

Zetterberg, & Unosson, 2001). However, the majority of literature on the impacts of music lacks rigorous methodology. For example, out of the 606 original articles, only 13 articles were further analyzed for a systematic review analysis, and only four articles were analyzed for a meta-analysis (Nightingale, Rodriguez, & Carnaby, 2013).

Another critical thing to consider is that, like art in healthcare environments as a positive distraction, music should also be carefully considered in spite of the above benefits. The main reason is that people's preferences for music vary among different age or culture groups (Lee, Chung, Chan, & Chan, 2005), and the beneficial impacts are generated once their preferences have been met (Allen & Blascovich, 1994). Therefore, not only the genre (e.g., classical, jazz, and pop) and the selection of music but also a choice of the presence or absence of music should be granted to occupants to allow a sense of control (Shepley, 2006).

Television

Television as an additional design element can be a positive distraction; however, there has been disagreement about its effects in healthcare environment (Devlin & Andrade, 2017). Pruyn and Smidts (1998) investigated patients' perceived waiting time and satisfaction with care in settings having either a turned-on television or a turned-off television in the waiting area. They found no role of positive distraction by televisions, but found that boredom, due to a long wait, lead patients to watch the television not for a positive distraction purpose. Ulrich and his colleagues (2003) found that lower levels of blood pressure among blood donors were reported in a setting with a turned-off

television, than in a setting with a turned-on television without any control over it. This finding reiterates the importance of having control over the environment.

In addition, different groups of occupants can have different reactions to the same environment. In other words, a distraction can be positive for someone, whereas it can be negative for others. For patients, a television in a waiting room can be a positive distraction, reducing their anxieties and stress; on the other hand, for staff members, who are exposed to the environment all day, it can be a negative distraction (Ulrich, 1991).

Even though more studies have explored the effects of televisions in waiting areas, a recent study identified how inpatients perceived televisions as positive distractions during hospitalization (Devlin et al., 2016). This qualitative study classified the physical environment features in a room into perceived control, social support, and positive distraction, based on the patients' lists regarding three characteristics of their rooms affecting their satisfaction with their experience at the hospital (Table 1). The most common comments relating to positive distractions were about television and other media (e.g., radio, newspaper, and music; 31.8%). Patients perceived that televisions were doing a great job to help them pass time and appreciated their presence in their rooms. However, patients also perceived televisions negatively by mentioning their locations and the limited television program stations. Those negative comments can be interpreted as an effect of the lack of control over the television, and the negative impact of a lack of control is well aligned with the findings above (i.e., higher blood pressure with a turned-on television without any control).

Smell/Aroma

Positive health outcomes (e.g., lower blood pressure and perceived pain, and slow respiration) have been reported as a benefit of pleasing aromas' among researchers (Schweitzer et al., 2004). For example, lower anxiety levels were reported among patients during magnetic resonance imaging (MRI) when a pleasant fragrance was diffused in the room, which is a positive smell (Redd et al., 1994). On the other hand, higher levels of anxiety, fear, and stress have been found as a result of negative smells (i.e., odor) (Schweitzer et al., 2004). Therefore, aroma can be a positive distraction to relieve patients' psychological and physiological status. The effectiveness of aromatherapy has been well documented among researchers, mostly in medical fields. Because of this, and as aromatherapy is one of the main topics of this research project, it will be discussed separately with more detail in the following section.

Ambient Scent Environment

To create ambient sensory environment, pleasing aroma is frequently embedded in environments. Aromatherapy combines the words aroma, meaning fragrance or smell, and therapy, meaning treatment (Ali et al., 2015). More specifically, aromatherapy can be defined as "the treatment of disorders and diseases using a distinctive or usually pleasant smell" (Lis-Balchin, 1997, p. 324). Posadzki, Alotaibi, and Ernst (2012) later defined aromatherapy as the controlled use of essential oils extracted from plants through distillation for therapeutic purposes (e.g., physiologic or pharmacologic effects). In addition, Yim et al. (2009) referred essential oils to "the volatile and organic constituents of fragrant plant matters that contribute to the flavor and fragrance" (p. 188).

Essential oils can penetrate the body and generate pharmacological effects through oral, dermal (massage or topical application), or olfactory systems (inhalation) (Sánchez-Vidaña et al., 2017). The botanical classification of plants for extracted essential oils determines essential oils' classification (Clarke, 2008). In addition, chemotypes can be further classified into different chemical profiles, such as different types and quantities of chemical components, based on different subspecies of plants; therefore, the main combination of essential oils can be explained through the chemotypes (Buckle, 2014). Even though different concentrations of essential oils are used for different methods (e.g., lower concentrations for aromatherapy massage, and higher concentrations for oral and inhalation aromatherapy), there are no standards for dosage and dilution in practice yet (Sánchez-Vidaña et al., 2017).

History of Aromatherapy

Although the earliest use of essential oils as aromatic medicine was in the 1930s, aromatic plants, as part of herbal medicine, have been used for several thousand years and in the many civilized geographical areas, such as China, India, France, UK, Egypt, etc. (Ali et al., 2015; Buckle, 2014). The distillation technology of our ancestors to extract essential oils from plants has contributed hugely to the contemporary concept of aromatherapy. Owing to this technology, aromatherapy began to be used in the early 20th century for clinical purposes in France and became popular (Buckle, 2014). Since then, it has been widely spread all over the world, as a form of aromatherapy which is familiar to people nowadays, and it is also known as aroma science therapy (Ali et al., 2015).

How Aromatherapy Works with Body Systems

Aromatherapy can be used distinctively depending on different types and methods. To be specific, Buckle (2014) categorized aromatherapy into three different types: aesthetic, holistic, and clinical. Aesthetic aromatherapy can be essential oils in perfume for a purpose of its pleasant aroma, and holistic aromatherapy includes relaxation or energization of the mind, body, and spirit via a mixture of essential oils. Lastly, clinical aromatherapy tries to relieve a specific clinical symptom, such as nausea, and to measure outcomes. The primary methods for using aromatherapy are inhalation, massage, and oral ingestion (Karadag, Samancioglu, Ozden, & Bakir, 2017), since the skin and olfactory systems (internal as well as external) can absorb essential oils (Buckle, 2014; Jager, Buchbauer, Jirovetz, & Fritzer, 1992). In addition, as France started to use aromatherapy for clinical purposes in the 1930s, physicians in France have even used it via oral, rectal, and vaginal routes. In particular, essential oils can be absorbed via external skin through massage, and via internal skin through mouthwashes, gargles, and douches. Inhaled absorption can occur directly or indirectly, with or without steam, through diffusers, humidifiers, aromas ticks, etc. Lastly, oral absorption includes ingesting any capsules or food (e.g., honey) containing essential oils (Buckle, 2014). In this literature review, only aromatherapy via the olfactory system will be discussed.

For absorbing essential oils into the body system, inhalation, assumed to be the oldest method, is known as the fastest method (Buckle, 2014). During aromatherapy inhalation, the components move into the circulation system through the nose and lungs, and eventually reach the brain through those olfactory systems, by provoking certain

hormones in the brain, such as endorphins (Buckle, 2014; Sánchez-Vidaña et al., 2017). Once the components of essential oils enter the olfactory systems and stimulate those cells in the systems, the signal is transmitted to the brain. Finally, the transmitted signal evokes emotional stimulation due to the essential oils (Ali et al., 2015; Burnett, Solterbeck, & Strapp, 2004).

Complementary and Alternative Medicine (CAM)

Complementary and alternative medicine (CAM) can be defined as a set of broad healing systems (e.g., products, practices, and approaches) for preventing, diagnosing, and treating diseases, not as part of conventional (western) medicines (Barnes et al., 2004; Sánchez-Vidaña et al., 2017). The usage of CAM among the U.S. population has dramatically increased since the 1990s, and according to the National Health Interview Survey (NHIS) in 2002, almost one-third of adults used at least one type of CAM (Barnes et al., 2004). In addition, approximately 75% of surgical patients showed their willingness to use CAM (Wang, Caldwell-Andrews, & Kain, 2003). Patients having life threatening diseases, such as cancer or HIV, especially, have a higher CAM use rate (Barnes et al., 2004).

This remarkable increase in CAM's use can be explained by dissatisfaction with traditional (conventional) medicines due to the unpleasant side-effects (Lis-Balchin, 1997; Yim et al., 2009). According to Wang et al. (2003), the prevailing reason for CAM usage was "fewer or no side effects" (35%) followed by "works better or as well as traditional medicine" (11%). This dissatisfaction with traditional medicines may come from traditional medicine's inability to treat chronic diseases and symptoms (e.g., pain)

(Barnes et al., 2004). For example, patients with depression are mainly treated with medications, but the side-effects, such as headaches, insomnia, and nausea, cause the treatment not to be done in nearly one third of cases (Yim et al., 2009). Therefore, to compensate the shortcomings of traditional medicines, CAM has been given attention. Indeed, 53.5% of depression patients in the USA use CAM for their adjuvant therapy (Yeung et al., 2015).

As an inexpensive and non-invasive method of CAM, patients often choose aromatherapy to enhance their wellness (Ndao et al., 2012; Sánchez-Vidaña et al., 2017; Setzer, 2009). Aromatherapy can enhance their wellness via diverse ways (e.g., mental, psychologic, spiritual, and social wellness), despite the difficulty of measuring it quantitatively and objectively (Lee, Wu, Tsang, Leung, & Cheung, 2011). In addition, even though the effect of aromatherapy is still debated, compared with traditional medicines, aromatherapy is widely known as a method having relatively fewer adverse effects. In the UK, the most frequently used CAM is aromatherapy, as its popularity has increased significantly (Hur, Song, Lee, & Lee, 2014).

Effectiveness of Aromatherapy as Clinical Treatments

As the popularity of aromatherapy has continuously increased, researchers also have constantly made attempts to investigate the effectiveness of aromatherapy as a clinical treatment. The well-known major benefits of aromatherapy are improved quality of sleep, psychological status (e.g., reduced stress, anxiety, and depression), and physiological status (e.g., reduced pain and nausea). However, there have been few methodologically rigorous studies, as the majority of them are about anecdotal findings

rather than clinical trials (Howard & Hughes, 2008; Sarris & Byrne, 2011). In addition, researchers have still debated the effectiveness of aromatherapy as clinical treatments, and there are inconclusive decisions yet. The Table 2 well describes the current findings about aromatherapy.

Table 2

Current Findings about Aromatherapy and Its Impacts and Results

Study	Sample (N)	Dependent Variable(s)	Study design	Duration	Measurement tool(s)	Results
Ayan et al. (2013)	Patients (80)	Pain rating	RCT. Intervention vs placebo	While being treated in an emergency room	VAS, arterial pressure, pulse rate	+ Pain rating
Braden, Reichow, and Halm (2009)	Patients (150)	Anxiety	RCT. Intervention vs placebo vs control	Before surgery	VAS	+ Anxiety
Chien, Cheng, and Liu (2012)	Women with insomnia (67)	Sleep quality, heart rates	RCT. Intervention vs placebo	12 weeks (20 mins * 2 per week)	PSQI, heart rate	+ Sleep quality - Heart rate
Conrad and Adams (2012)	Postpartum women (28)	Anxiety, depression	RCT. Inhalation vs massage	4 weeks (15 mins * 2 per week)	EPDS, GAD-7	+ Anxiety + Depression
Fenko and Loock (2014)	Patients (21)	Anxiety	Cluster RCT. Intervention vs control	While waiting for an appointment	STAI, CAS, HADS, PEQI	+ Anxiety
Goel, Kim, and Lao (2005)	Healthy people (31)	Sleep quality	RCT. Intervention vs placebo	3 nights: 2 mins * 4 times per night	Polysomnographic Recordings, SSS, POMS	+ Sleep quality

Table 2 (Continued)

Current Findings about Aromatherapy and Its Impacts and Results

Study	Sample (N)	Dependent Variable(s)	Study design	Duration	Measurement tool(s)	Results
Graham, Browne, Cox, and Graham (2003)	Patients (330)	Anxiety, depression, health status	RCT. Intervention vs placebo	15-20 mins	HADS, SPEHRE	+ Anxiety - Depression - Health status
Hadi and Hanid (2011)	Woman patients (200)	Pain	RCT. Intervention vs control	16 hours	VAS	+ Pain
Holm and Fitzmaurice (2008)	Adults (1104)	Anxiety	Cluster RCT. Intervention vs control	While being treated in an emergency room	STAI	- Anxiety
Howard and Hughes (2008)	Healthy people (96)	Relaxation	RCT. Intervention vs placebo vs control	10 mins	STAI	- Relaxation
Igarashi (2013)	Pregnant women (13)	Health status	RCT. Intervention vs control	5 mins	POMS	- Health status
Karadag et al. (2017)	Patients (60)	Sleep quality, anxiety	RCT. Intervention vs control	15 days	PSQI, BAI	+ Sleep quality + Anxiety

Table 2 (Continued)

Current Findings about Aromatherapy and Its Impacts and Results

Study	Sample (N)	Dependent Variable(s)	Study design	Duration	Measurement tool(s)	Results
Kim et al. (2006)	Patients (50)	Pain rating	RCT. Intervention vs control	2 mins	Pain 10-point scale	- Pain rating
Kritsidima, Newton, and Asimakopoulou (2010)	Patients (340)	Anxiety	Cluster RCT. Intervention vs control	While waiting for an appointment	STAI, MDAS	+ Anxiety
Lehrner et al. (2005)	Patients (200)	Anxiety, mood	RCT. Intervention vs control	While waiting for an appointment	STAI, MDMQ, current pain	+ Anxiety + Mood
Louis and Kowalski (2002)	Patients (17)	Anxiety, depression, pain, blood pressure	Quasi-experimental. Intervention vs placebo vs control	3 days	Pain (NS), anxiety (NS), depression (NS), blood pressure, pulse	+ Anxiety, depression, pain, blood pressure
Lytle et al. (2014)	Patients (50)	Sleep quality, vital sign	RCT. Intervention vs control	8 hours	RCSQ, blood pressure	- Sleep quality + Blood pressure
Matsumoto, Asakura, and Hayashi (2014)	Healthy women (20)	Stress, mood	RCT. Intervention vs placebo	10 mins	POMS, salivary CgA	+ Stress +Mood

Table 2 (Continued)

Current Findings about Aromatherapy and Its Impacts and Results

Study	Sample (N)	Dependent Variable(s)	Study design	Duration	Measurement tool(s)	Results
Moeini et al. (2010)	Patients (64)	Sleep quality	RCT. 9-hour diffused aroma vs control	3 nights	SMHSQ	+ Sleep quality
Muzzarelli, Force, and Sebold (2006)	Patients (118)	Anxiety	RCT. Intervention vs placebo	Before surgery	STAI	- Anxiety
Ndao et al. (2012)	Patients (37)	Pain, anxiety, nausea	RCT. Intervention vs placebo	Before SCT	STAI, CBSS, VAS, EASI	- Pain, anxiety, nausea
Raudenbush, Koon, Meyer, Corley, and Flower (2004)	Healthy people (158)	Pain rating, pain tolerance	RCT. Intervention vs control	5 mins	POMS, STAI, NASA-TLX	+ Pain rating + Pain tolerance

Note. Created by Suyeon Bae. * BAI: Beck Anxiety Inventory, CAS: Clinical Anxiety Scale, CBSS: Children's Behavioral Style Scale, EASI: Emotionality Activity Sociability and Impulsivity, EPDS: Edinburgh Postnatal Depression Scale, GAD-7: Generalized Anxiety Disorder Scale, HADS: Hospital Anxiety and Depression Scale, MDAS: Modified Dental Anxiety Scale, MDMQ: Multidimensional Mood State Questionnaire, NASA-TLX: NASA Task Load Index, NS: Not Specified, PEQS: Physical Environment Quality Scale, POMS: The Profile of Mood States Questionnaire, PSQI: Pittsburg Sleep Quality Inventory, RCSQ: Richard Campbell Sleep Questionnaire, SCT: Stem cell transplantation, SMHSQ: St. Mary's Hospital Sleep Questionnaire, SPHERE: Somatic and Psychological Health Report, SSS: The Stanford Sleepiness Scale, STAI: State-Trait Anxiety Inventory, VAS: Visual Analog Scale, +: significant improvement, -: non-significant relationship

Quality of Sleep

Undoubtedly, sleep is one of the most critical parts for achieving wellness, because sleep itself has its own therapeutic benefit. For this reason, insomnia makes people vulnerable to other symptoms, like depression, and indeed, almost half of patients suffer from both insomnia and depression simultaneously (Arroll et al., 2012). In addition, insufficient sleep hinders healing processes by negatively influencing immune systems, stress, and anxiety (Lytle et al., 2014). However, healthcare environments do not usually provide patients with relaxing environments; as a result, most patients often have a hard time sleeping due to strange environments, such as unfamiliar beds, smells, noises, and routines (Buckle, 2014). Therefore, to aid sleep disorders among patients, aromatherapy has been investigated in healthcare settings.

Lavender essential oil is the most frequently used one for improving quality of sleep (Buckle, 2014), because it brings relaxation, sedative effects, and soothing muscles, which can help sleep improvement (Karadag et al., 2017). To be specific, to study the impact of olfactory stimuli during nighttime sleep, Goel et al. (2005) tested 31 healthy people for three consecutive nights with either a lavender oil inhalation or distilled water (placebo) inhalation stimulus. The authors found enhanced sleep quality (e.g., deep or slow-wave sleep) for those who received the lavender oil stimuli and concluded that lavender can be a mild sedative to promote deep sleep.

Another experimental study of patients with heart disease investigated the association between lavender aromatherapy and sleep quality (Moeini et al., 2010). For three nights, patients in the experimental group were exposed to a nine-hour diffused

aromatherapy, while patients in the control group were exposed to no aromatherapy. The self-reported sleep quality results indicated that patients who were exposed to the aromatherapy had significantly better sleep quality than patients who were not.

Experimental research was also conducted to find lavender aromatherapy's impact on insomnia among 67 women aged 45 to 55, by measuring self-reported sleep quality and heart rates (Chien et al., 2012). For the experimental group, aromatherapy inhalation was given for 20 minutes, twice a week, for 12 weeks (in total, 24 times). There was a significant difference in self-reported sleep quality, but not in heart rates, between the experimental and control groups. These results may imply that lavender aromatherapy inhalation positively impacted the quality of sleep.

To see the effectiveness of aromatherapy inhalation on patients' vital signs (e.g., blood pressure, heart rate, and respiratory rate) and perceived quality of sleep, 50 patients in an intermediate care unit were examined through a randomized controlled study (Lytle et al., 2014). While patients in the control group received regular care, patients in the experimental group received a glass jar containing lavender oil, which was placed at bedside at night (from 10 pm to 6 am). Patients who had the lavender oil jar next to their beds had significantly lower blood pressure than patients who did not have the jar, especially, between midnight and 4 am. Even though the authors found a higher perceived quality of sleep among patients in the experimental group than in the control group, the difference was not statistically significant.

A recent randomized controlled study also explored lavender aromatherapy's influence on the quality of sleep and anxiety by having patients in an intensive care unit

inhale aromatherapy for 15 days (Karadag et al., 2017). The authors compared self-reported sleep quality and anxiety scores. They found better sleep quality and anxiety scores among patients who received the lavender intervention than patients who did not, and those differences were statistically significant. Therefore, the authors concluded that aromatherapy can be a non-invasive, inexpensive, and easily applicable treatment for patients.

However, Howard and Hughes (2008) cast doubt on aromatherapy's impacts by conducting a double-blinded placebo-controlled trial. Ninety-six healthy participants were assigned into lavender aroma, placebo, or no aroma groups, and participants in the aroma groups (either lavender or placebo), especially, received different instructional primes, either positive or negative impact. There was no difference in relaxation among participants in the three groups. However, the instructional prime leading to participants' expectancies that they received lead to differences in relaxation. In conclusion, the authors mentioned that the prevailing association between aromatherapy and relaxation may be actually driven by expectancy biases.

Stress, Anxiety, and Depression

Stress, anxiety, and depression are three common health concerns in modern society. Anxiety, as a one of the symptoms of stress, in fact, is frequently interpreted as a synonym for stress (Buckle, 2014). Anxiety happens among approximately 6% of the world's population, and comes with various symptoms, such as high blood pressure and heart rate, fatigue, and unpleasant feelings (Smith, 2008). Likewise, according to a report about depression by the WHO in 2016, almost 350 million people in the world have

depression, as the most concerning health issue in the 21st century (Sánchez-Vidaña et al., 2017). Patients in healthcare environments are especially vulnerable to these psychological illnesses (i.e., stress, anxiety, and depression), because they often lose their sense of control and identity, and feel helpless (Buckle, 2014). More importantly, the high stress levels of patients may hinder their recovery processes and prolong the length of stay (Marshall, 2011). Therefore, as a quick, simple, and inexpensive method dealing with stress, aromatherapy often has been investigated by researchers.

For instance, Braden et al. (2009) conducted a randomized controlled experiment with 150 patients who were admitted for surgery. In addition to the standard care before surgery, the experimental group received inhalation aromatherapy, and the placebo group received placebo inhalation intervention. However, the control group only received the standard care. Significantly lower anxiety levels among patients who received aromatherapy implied that aromatherapy can be a simple and cost-effective intervention to improve patients' outcomes.

The impact of aromatherapy while waiting at a dental clinic has been investigated by a few studies. Two hundred patients were exposed to either an ambient odor environment (lavender or orange), an ambient sound environment, or a control environment (Lehrner et al., 2005). The results suggested that patients reported lower anxiety and better mood while waiting in the ambient odor environments. In another cluster randomized controlled trial, 340 patients waiting for a dental appointment were investigated in a setting either having lavender scent or not (Kritsidima et al., 2010). The

authors compared self-reported anxiety scales and found a significantly lower anxiety level among patients in a setting with lavender scent.

Conrad and Adams (2012) further explored the effects of clinical aromatherapy on anxiety and depression among 28 postpartum women through a randomized controlled pilot study. The participants were randomly assigned to either inhalation aromatherapy or aromatherapy massage for two 15-minute sessions a week for four consecutive weeks. The rest of the participants for the control group were asked not to do aromatherapy for the four weeks; while every participant received the continued allopathic medical treatment. Although there was no significance difference in anxiety and depression between the experimental and control groups at baseline, there were significant improvements on anxiety and depression between the two groups at both the midpoint (two weeks from the baseline) and final point (at the end of the intervention period).

To test the soothing effects of aromatherapy, another randomized controlled pilot study with 20 healthy women was conducted in Japan (Matsumoto et al., 2014). The participants inhaled either aromatherapy or unscented water twice during the experiment. The levels of salivary chromogranin A (CgA), which is a physiological marker to measure stress, decreased significantly after ten minutes of aromatherapy inhalation, and decreased even further after 30 minutes. Furthermore, the self-reported mood states among participants who received aromatherapy had improved.

However, there are several studies that have found conflicting results for aromatherapy on psychological status. For example, contrary to the findings by Lehrner et al. (2005) (reduced anxiety levels and improved mood in the ambient odor

environment rather than in the ambient sound environment at dental waiting areas), Holm and Fitzmaurice (2008) found contradictory results in pediatric emergency department waiting areas. The participants were exposed to one of four settings, providing: 1) no intervention, 2) classical music with 60 to 70 beats per minute, 3) aromatherapy, or 4) both music and aromatherapy. Although music had a positive impact on decreasing anxiety levels, aromatherapy did not. Another study in a similar setting, which was the waiting area for a plastic surgeon, found different results from similar previous studies (e.g., Holm & Fitzmaurice, 2008; Lehrner, 2015) (Fenko & Loock, 2014). There were four different settings: 1) no intervention, 2) aroma scent, 3) instrumental music, and 4) both aroma scent and music. Reduced anxiety levels were found in both the music and aroma scent settings, but no impact on anxiety was found in the combination setting.

In addition, 330 patients were randomly assigned to either an aromatherapy inhalation setting or a placebo inhalation setting during their radiotherapy (Graham et al., 2003). There were no significant differences in self-reported depression and psychological health status, but only in self-reported anxiety. In another study, the impact of aromatherapy for soothing anxiety in a waiting room was investigated with 118 patients (Muzzarelli et al., 2006). Patients in the experimental group received aromatherapy inhalation, whereas patients in the control group got placebo inhalation. Although patients reported that the aromatherapy had a pleasant scent, their anxiety levels were not affected by the aromatherapy.

A recent study by Igarashi (2013) also cast doubt on the effectiveness of inhalation aromatherapy on psychological and physiological wellness. The author found

that, even though there was an improvement of health status within the experimental group, which was exposed to the inhalation aromatherapy, there was no impact compared to the control group, which was not exposed to the aromatherapy. However, it could be that the small number of participants contributed to their not finding any differences between the groups. In conclusion, as mentioned above, the effectiveness of aromatherapy is still debated, and the lack of standards for using aromatherapy, in terms of dosages, directions, and duration, may lead the inconclusive results among researchers (Sánchez-Vidaña et al., 2017).

Pain

As an undesirable feeling, pain is one of the most frequent symptoms patients can have in clinical settings (Buckle, 2014). Chronic pain, especially, has become more prevalent than before, and almost 100 million people in the U.S. suffer from chronic pain (Buckle, 2014). Aromatherapy can provoke endorphins, which are associated with pain, via the olfactory systems by enhancing the parasympathetic response (Weil, 2000). Indeed, pain tolerance was increased by a sweet aroma inhalation (Prescott & Wilkie, 2007). In addition, aromatherapy may alleviate chronic pain, because essential oils contain many of analgesic components, and pharmacologically active components in essential oils can create synergy with orthodox pain medicines by helping absorption (Buckle, 2014). For these features, aromatherapy is frequently used during pain treatments in many countries, such as the U.S., UK, Australia, Canada, etc. (Buckle, 2014). Moreover, researchers have paid their attention to the effectiveness of aromatherapy on pain relief. However, similar to other symptoms discussed above, the

discussion over aromatherapy's impact on pain relief has not been reached an agreement among researchers yet.

To examine aromatherapy's effectiveness on pain relief, either topical or oral aromatherapy mostly have been investigated; while inhaled aromatherapy was studied by a few. For example, Raudenbush et al. (2004) conducted an experimental study and found the effects of aromatherapy inhalation on pain. One hundred fifty-eight participants reported pain level during a cold pressor test and were exposed to either low-flow oxygen, peppermint odor plus oxygen, or jasmine odor plus oxygen. The authors found significantly lower pain ratings and higher pain tolerance among participants who were exposed to the aroma odor settings.

Louis and Kowalski (2002) identified a positive yet small improvement not only in pain, but also in blood pressure, pulse, anxiety, depression, and sense of well-being among 17 cancer hospice patients in a humidified aromatherapy environment rather no treatment or placebo environments. Through a single-blinded randomized controlled trial with 200 women after cesarean surgery, Hadi and Hanid (2011) also found the positive impacts or aromatherapy on reduced pain. Patients were randomly assigned to the aromatherapy inhalation or placebo inhalation, and a higher improvement was found in the aromatherapy group than the placebo group.

In addition, to learn any possible effects of rose essential oils on the relief of renal colic pain, 80 patients diagnosed with renal colic were received either a placebo inhalation or an aromatherapy inhalation, in addition to the conventional therapy for both groups (Ayan et al., 2013). At the beginning of the treatment, there was no significant

difference in pain ratings between two groups, but 10 or 30 minutes after the treatment, patients who received aromatherapy as well as conventional therapy had lower pain rating than patients in the placebo group.

However, no effectiveness of soothing pain by aromatherapy also has been reported by other studies. For instance, 50 patients after breast surgery received either supplemental oxygen with or without lavender oil (Kim et al., 2006). Even though a higher satisfaction with pain control was reported among patients who received lavender oil with supplemental oxygen, the actual pain scores were not significantly different between two groups. Another study was not able to find any improvement in pain, anxiety, and nausea of aromatherapy (Ndao et al., 2012). A double-blind and placebo-controlled randomized study let 37 pediatric patients exposed to either aromatherapy or non-aromatherapy. Whether or not patients inhaled aromatherapy did not affect the statistically significant difference in the reduced pain, anxiety, and nausea. Assuming those conflicting findings, like Buckle (2014) mentioned, the perception of pain may have more close relationship with inhaled aroma, than the actual pain.

Current Gaps in the Research About Ambient Scent Environment

All things taken together, the effectiveness of ambient scent environment (e.g., physiological and psychological wellness) in clinical settings is still in debates, even though there is a growing body of knowledge about aromatherapy in clinical settings. Moreover, the majority of the evidence for aromatherapy has been still released as case studies or case series (Posadzki et al., 2012), rather than peer-reviewed journals (Lee, Choi, Posadzki, & Ernst, 2012). Furthermore, most of the articles from peer-reviewed

journals are about patients in hospitals rather than patients in rehabilitation centers. Consequently, there is no consensus on the standards to use aromatherapy as clinical treatments or positive distractions yet. Therefore, aromatherapy should be tested by various populations based on their health status and diverse environments (e.g., hospitals, rehabilitation units, residences, etc.) with rigorous study designs.

Residents in Long-Term Care Facilities

In the United States, nursing homes are a long-term care (LTC) facility providing healthcare services not only for the elderly but also for younger people who have various physical/mental conditions (Dickinson, 2004). In other words, LTC, or resident care can be defined as "any personal care or assistance that an individual might receive on a long-term basis because of a disability or chronic illness that limits his or her ability to function" (as cited in Joseph, Choi, & Quan, 2016, p.1204). Therefore, LTC includes a range of settings, such as nursing home, supportive residential care, assisted living facility, rehabilitation facility, and an individual's home (Joseph et al., 2016). There are approximately 15,600 nursing homes in the United States in 2014, according to a 2015 report by the Centers for Medicare and Medicaid Services (CMS) (2015). Over the past 10 years, the number of nursing homes has slightly decreased, but it remains steadily over the past five years. To be more specific, the number of nursing homes has increased in 19 states, while it remains steady in seven states and has decreased in the other 24 states in the United States (CMS, 2015).

Table 3

Demographic Information about Residents in Nursing Homes in the United States in 2014

		Number	Percentage
Gender	Male	483,516	34.4
	Female	922,704	65.6
Age	0-21 years	2,758	0.2
	22-30 years	4,509	0.3
	31-64 years	210,655	15.0
	65-74 years	232,077	16.5
	75-84 years	371,295	26.4
	85-95 years	475,050	33.8
	95+ years	109,859	7.8
Number of ADL Impairments	0	278,506	19.8
	1	81,066	5.8
	2	72,643	5.2
	3	86,405	6.2
	4	574,238	40.9
	5	311,250	22.2
Cognitive Impairments	None to mild	542,926	38.7
	Moderate	347,901	24.8
	Severe	513,867	36.6
Pain in Past 5 days	None	731,838	65.5
	Mild/Infrequent	249,259	22.3
	Moderate/Severe	135,944	12.2
Total		1,406,220	100.0

Note. ADL: Activities of Daily Living. Source from Nursing Home Data Compendium 2015 Edition by Centers for Medicare and Medicated Services, 2015. Edited by Suyeon Bae, 2019

In 2014, more than 1.4 million patients resided at nursing homes, and the number of residents in nursing homes has grown slightly but steadily over the past few decades (Centers for Disease Control and Prevention, 2016) . Based on the same report by CMS (2015) cited above, among the 1.4 million patients at nursing homes in the United States in 2014, almost two-thirds of residents were female (65.5%), and the majority of residents were over 65 years old (84.5%) (see Table 3). About 20 percent of residents do not have any Activities of Daily Living (ADL) impairments, and almost one-third of

residents (38.7%) have none to mild cognitive impairment. In addition, 11.1% had no impairment regarding both ADL and cognitive impairment, while 14.9% had both ADL impairment of the level five and severe cognitive impairment (see Table 3).

As the above national data indicates (Table 3), the majority of the elderly resident population in LTC are vulnerable based on their physical and cognitive impairments. To be specific, they are more likely to suffer from psychological disorders as compared to other older people living in non-institutional settings (Seitz, Purandare, & Conn, 2010). As cognitive impairment, dementia is one of the most common psychological disorder among residents in LTC (Balestreri, Grossberg, & Grossberg, 2000). For example, according to a recent systematic review paper by Seitz et al. (2010), among 30 studies, the median prevalence of dementia is 58% and the median prevalence of psychological symptoms of dementia is 78%. However, there is yet a significant population of elderly in LTC who are not cognitively impaired but are at risk of developing mental health disorders as patients in an LTC environment.

Depression is also a major risk factor among LTC patients with a high prevalence of depression: 15.5% for major depression; 25.7% for minor depression; and 50% for depressive symptoms (Barca, Engedal, Laks, & Selbaek, 2010; Smalbrugge, Jongenelis, Pot, Beekman, & Eefsting, 2005). Moreover, even though depressive symptoms have a close association with mortality among older patients, treating the symptoms is not easy because depression in late-life develops as a results of diverse and complex reasons (e.g., health condition, cognitive status, social support, etc.) (Chen, Huang, & Chen, 2014). In addition to those complicated etiologies, depression patients frequently suffer from the

side effects of conventional medicines. Therefore, as mentioned in the earlier section, more than half of depression patients in the United States treated their symptoms through complementary and alternative medicines (Yeung et al., 2015).

Anxiety is less common than depression among LTC patients, but is still considered as a high-risk factor (i.e., 3.5% for anxiety disorders and 13.5% for subsyndromal anxiety disorders) (Smalbrugge et al., 2005). Moreover, patients with comorbid depression and anxiety are regarded as the most vulnerable patients, as their responses to treatment are usually slow and even reduced.

Interior Environments in Long-Term Care Facilities

As the older population is continuously growing, the number of adults older than 65 years in age will double between 2050 and 2010, reaching almost 89 million in the United States (National Center for Health Statistics, 2013). In addition, by 2050, as the lifespan of older adults increases, more than one fifth of the adults older than 65 will be the "oldest old" (older than 85), reaching nearly 19 million in the United States (Jacobson, Kent, Lee, & Mather, 2011). Therefore, researchers emphasize the increasing need for quality housing and care environments for the elderly (Joseph et al., 2016). For this reason, studies about physical environments in long-term care facilities and the occupants' well-being have continuously reported that beneficial environments can increase residents' higher quality of life (Joseph, 2006a; Joseph et al., 2016).

The nature of care in long-term care facilities is different from in hospitals in that a hospital provides acute care with medical or surgical treatment in the short-term, whereas a long-term care facility provides general care to look after people in long-term

(Ward, Drahota, Gal, Severs, & Dean, 2008). Therefore, it would be reasonable to refer to people who are taken care of in hospitals as *patients* and in long-term care facilities as *residents*. On the other hand, long-term care facilities are similar to hospitals in that patients/residents may feel uncomfortable staying in such places because they do not feel like their actual homes. Like hospitalization of hospital patients, long-term care facilities residents can experience high levels of stress, anxiety, and discomfort due to hospitalization (Ouslander et al., 2010).

Sense of Home

As patients in hospitals perceive healing spaces as home-like environment (MacAllister et al., 2016), the experience of feeling at home is also important to residents in long-term care facilities due to the long length of stay (De Veer & Kerkstra, 2001). De Veer and Kerkstra (2001) conducted individual interviews with 686 residents in 36 different long-term care facilities, and found that the level of privacy and not being disturbed by other residents are important factors related to feeling at home. The results agreed with previous findings of the positive impact of a degree of personalization in residents' rooms on their satisfaction with long-term care facilities (Kruzich, Clinton, & Kelber, 1992) and the positive influence of perceived control on psychological well-being among residents in long-term care facilities (Brubaker, 1996). Specifically, one review paper categorized 15 social and built environmental factors, which influence the sense of home among long-term care facilities residents, into three themes:

1) psychological factors (sense of acknowledgement, preservation of one's habits and values, autonomy and control, and coping);

2) social factors (interaction and relationship with staff, residents, family and friends, and pets) and activities; and

3) the built environment (private space and (quasi-)public space, personal belongings, technology, look and feel, and the outdoors and location) (Rijnaard et al., 2016, p. 57).

In summary, a homelike environment in long-term care facilities should be encouraged to minimize a sense of institutionalized living by allowing residents to bring personal belongings, granting autonomy and freedom, and keeping a sense of privacy (Rijnaard et al., 2016).

Nature/Garden/Outdoor Environments

Another environmental factor influencing the quality of life among residents in long-term care facilities is having outdoor environments, such as gardens (Joseph et al., 2016). For example, Rodiek (2002) found that residents who were exposed to outdoor green environments had a significantly lower cortisol level than others who stayed indoors. In addition, Rappe, Kivelä, and Rita (2006) discovered that frequent outdoor visits are highly related to higher self-reported health among residents in a long-term care facility. Providing a wander garden in long-term care facilities is also beneficial to residents with dementia in that it reduces the number of falls and the use of antipsychotics and improving sleep quality (Detweiler, Murphy, Kim, Myers, & Ashai, 2009). In conclusion, not only patients in hospitals but also residents in long-term care facilities can improve their quality of life through the restorative effects of nature.

Ambient Environment

Lighting is an important environmental factor for residents in LCT, because they often suffer from circadian disruption symptoms (e.g., depression, difficulty sleeping, frequent daytime napping, and loss of cognitive ability) (White, Ancoli-Israel, & Wilson, 2013). Therefore, lighting has been frequently investigated in healthcare settings with different intensities and durations of lighting (White et al., 2013). For example, a study with Alzheimer patients in a long-term care (LTC) facility found that patients had increased quality of sleep after being exposed to light at 2500 lux for two hours either in the morning or evening (Ancoli-Israel, Martin, Kripke, Marler, & Klauber, 2002). Another study found increased social and physical activity but reduced daytime sleeping among 118 nursing home residents after they were exposed to sunlight or artificial light at 10,000 lux for 30 minutes (Alessi et al., 2005). In addition, Riemersma-Van Der Lek et al. (2008) investigated 189 residents at care facilities and randomly assigned them into either whole-day (from 9 am to 6 pm) bright (1000 lux) or whole-day dim (300 lux) light for 3.5 years. The results showed improvements in cognition, mood, behavior, functional abilities, and sleep among the residents who were exposed to whole-day bright.

Like these studies about the impact of lighting on the health of elderly people, White et al. (2013) concluded that circadian disruption symptoms among residents in nursing home can be alleviated by an evidence-based design of a 24-hour light/dark environment after reviewing 18 randomized controlled trials. The authors also addressed the importance of darkness management, along with light management. However, according to a study conducted by Sinoo, van Hoof, and Kort (2011), the lighting

conditions of seven nursing homes in the Netherlands were inferior than the standard threshold. The authors found that at least 55% of the measurements for vertical illumination and 65% of the measurements for horizontal illumination were below the 750 lux threshold, especially in corridor areas, except the window zones. In addition, there was a significant difference in lighting color temperature between old and new nursing home buildings (Sinoo et al., 2011).

Additional ambient environmental factors improving residents' well-being in nursing homes also has been studied. For example, one study examined the impacts of environmental factors (e.g., temperature, noise, and lighting) in nursing homes on quality of life among residents with severe dementia (Garre-Olmo et al., 2012). The authors found that high temperature and low lighting levels in residents' bedroom and high noise levels in the living room had negative impacts on their quality of life. In a one-year parallel group intervention study, non-institutional physical environment and atmosphere of the dining room (e.g., plants/flowers on the tables, music, and tablecloths), in addition to better food service and nursing staff, positively affected weight gain and increased dietary intake (Mathey, Vanneste, de Graaf, De Groot, & Van Staveren, 2001).

Furthermore, to investigate the impact of the physical environment on wandering behavior among residents suffering from dementia, a cross-sectional study analyzed 122 residents' wandering behaviors which were videotaped at 28 different long-term care facilities (Algase, Beattie, Antonakos, Beel-Bates, & Yao, 2010). Wandering behavior can be dangerous, especially, for dementia patients due to a high risk of negative events, such as getting lost, injury, and death (Algase et al., 2010). The study found that wandering

behaviors reduced when the residents were exposed to environments with brighter light, more variation in acoustic levels, proximity to others, and a more engaging atmosphere. Another study also found the importance of environmental factors for dementia residents in nursing home (Wong, Skitmore, Buys, & Wang, 2014). The study conducted focus groups with nursing staff in Hong Kong and the results indicate that the acoustic, thermal, and lighting environments are the most critical environmental factors for residents with dementia in nursing homes.

To conclude, ambient environments, such as light, temperature, and noise, are influential factors to improve residents' quality of life in nursing homes, as in hospitals; however, more studies are needed (Joseph et al., 2016).

Interior Layout and Materials

Moreover, researchers have also explored that the relationships between environmental factors in long-term care facilities and residents with violent behaviors. In a cross-sectional study, violent behaviors were influenced by various environmental factors (e.g., a higher number of beds, more residents, longer corridors, and more corridor area) (Isaksson, Åström, Sandman, & Karlsson, 2009). However, the authors indicated that other factors, such as behavior index and psychiatric index, are more influential in reducing violent behaviors than environmental factors. A year later, another study found no association between residential density in nursing homes and neuropsychiatric symptoms among dementia residents (Zuidema, de Jonghe, Verhey, & Koopmans, 2010).

The diverse characteristics of interior environments in long-term care facilities have been explored in the light of improving residents' safety during their hospitalization. As falls are one of the common and important issues among long-term care facilities residents, a wide range of environmental modifications (e.g., rearranging or removing furniture, adding grab bars, improving lighting, and placing adjustable beds and chairs) have been implemented and their positive influences on reduced falls have been reported (Joseph et al., 2016). In addition, by pointing out the importance of appropriate environmental cues for residents' better gait and posture against falls, texture of the flooring was found as the most influential characteristic in a positive perception of safety (Zamora, Alcántara, Artacho, & Cloquell, 2008).

In conclusion, the preferred interior environments (e.g., nature, garden, and ambient environments) to improve residents' well-being in long-term care facilities have a number of similarities with the endorsed interior environments in hospitals. There are additional environmental characteristics (e.g., dining rooms and corridors) discussed in the literature on rehabilitation environments rather than hospital environments due to the different nature of the facilities. However, there is still lack of evidence regarding long-term care facilities environments compared to hospital settings, and more studies are needed to expand upon the inconclusive evidence.

METHODOLOGY

Research Design

A mixed method study was conducted to explore how interior environments and residents in long-term care facilities are related. To be specific, for a quantitative approach, a randomized controlled trial design was applied to investigate and measure how the ambient scent environment intervention facilitates residents' wellness during rehabilitation. Interior environments in long-term care facilities was manipulated by adding ambient scent for olfactory stimulation (i.e., pleasing aroma). The participants' wellness (e.g., depression and quality of sleep) was verbally measured by self-reported questionnaires and was analyzed by quantifying the responses. For a qualitative approach, a structured interview, as a post experimental interview, with a small number of open-ended questions was applied to see how participants perceive the intervention and their living spaces. These additional open-ended questions were helpful to gain more detailed responses beyond the scope of the questionnaires.

According to Johnson and Onwuegbuzie (2004), mixed methods research can be defined as "the class of research where the research mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (p. 17). A mixed method study is the most suitable design for this study, because it can answer broader and more complicated research questions by using multiple approaches and by compensating the weaknesses in each method (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2010). For this study, a post-experimental

interview was beneficial since it can play a role as a manipulation check as well as provide additional information.

Randomized Controlled Trial Design

A randomized controlled trial design was applied to explore the associations between an ambient scent environment, as a positive distraction, providing olfactory stimulation and residents' wellness in long-term care facilities. Randomized controlled trials (RCT) can be defined as "studies participants are assigned by chance, following a pretest, to at least two conditions: an experimental treatment or intervention, and a control intervention used for purposes of comparison on outcomes" (Solomon, Cavanaugh, & Draine, 2009, p. 5). RCT is considered the gold standard of scientific evidence because it is the most rigorous study design as well as evaluates the policy and practice interventions' effectiveness (Blumenthal & DiClemente, 2003; Solomon et al., 2009). There are several types of RCTs. Individual trials allocate treatment at the individual level, while community trials allocate treatment at the level of the community; preventive trials provide preventive agent to healthy or diseased individuals, whereas therapeutic trials provide treatments to diseased individuals; parallel trials assign one treatment to each group while crossover trials assign all treatments to each group one after another; and simple trials provide one treatment to each group whereas factorial trails provide two or more treatment to each group (Aschengrau & Seage, 2013).

The greatest strengths of RCT are random assignment because it eliminates selection bias, validity regarding statistical analysis (Blumenthal & DiClemente, 2003), and availability to use placebo control for outcome ascertainment (Aschengrau & Seage,

2013). However, the expense and time commitment can make researchers hesitate to use RCT more frequently (L. M. Sullivan, 2011). In addition, there may be numerous ethical issues when designing and conducting RCTs (Aschengrau & Seage, 2013).

Since the ambient scent intervention providing olfactory stimulation for this study was randomly assigned to the participant's private room, the effectiveness of the intervention was analyzed by comparing two different groups with minimized selection bias due to the randomization. For this study, the participants were randomly assigned to either a placebo group or an intervention group. In addition, only the participants were blinded by not informing them of group allocation, as the data were collected and analyzed by a sole investigator who is not blinded. Therefore, a RCT with a single blinded design was applied to answer the research questions for this study.

Because the placebo group receives a dummy intervention that resembles the experimental intervention but is lacking the active component, a placebo-controlled trial can detect the effectiveness of the intervention (Castro, 2007). However, researchers have questioned the placebo-controlled trial and suggest that having a control (not receiving treatment at all), a placebo (receiving a dummy treatment), and an intervention (receiving a true treatment) groups altogether is the most rigorous study design to see the true efficacy of the treatment (Schatzberg & Kraemer, 2000). In addition, the generalizability of the findings may be threatened due to the lack of representativeness among the study participants who already consent to participate in the placebo-controlled trial (Schatzberg & Kraemer, 2000). Although there are major concerns with using a placebo-controlled trial, treating a placebo group as a control can still generate sound findings (Freedman,

1990). For this study, a placebo control group was appropriate because it was not a large-scale study (target sample size is 58) and was designed to investigate the true effectiveness of the intervention. In other words, as the target sample was divided into two groups rather than three groups, each group had a higher number of participants, which can be beneficial for powering statistical analyses. Moreover, as the placebo and intervention groups are compared to each other, so the effectiveness of the true stimulation (i.e., actual olfactory stimulation) can be evaluated.

This study employed blinding to conceal group allocation. As blinding can be defined as "the concealment of group allocation from one or more individuals involved in a clinical research study" (Karanicolas, Farrokhyar, & Bhandari, 2010, p. 345), there are three different blinding types: 1) single blind (blinded patients); 2) double blind (blinded patients and investigators); and 3) triple blind (blinded patient, investigator, and data analysist) (Misra, 2012). Knowing participant allocation to a particular group can affect their behaviors and responses in the study, because participants are aware the intervention they will receive (Karanicolas et al., 2010). Likewise, investigators may also treat differently participants with the group allocation. Moreover, blinded participants' behavior and responses may be influenced by interactions with the investigator, which refers as observer bias or experimenter effect (Holman, Head, Lanfear, & Jennions, 2015). Despite the possibility of observer bias due to not having blinded investigators, a single-blinded study was applied to minimize other possible sources of bias.

Interview

Interviews are one of the most commonly used qualitative data collection methods, and there are different types of interviews (i.e., structured, semi-structured, and unstructured interview) with a wide range of application in research (Creswell, 2013; Qu & Dumay, 2011). The interview can be defined as "a conversational practice where knowledge is produced through the interaction between an interviewer and an interviewee (or a group of interviewees)" (Brinkmann, 2014, p. 1008-1009). The common way to distinguish the different types of interviews is the degree of structure with the term "standardized" often used to indicate "structured interview" (Qu & Dumay, 2011). Structured interviews have the structured/standardized questions in a rigid set, and the interviewer asks the same questions in the same order. Because the questions in structured interviews give a limited choice over the response (e.g., brief answers or answers from a list), they are relatively easy to collect more data than any other types of interviews and can generate quantifiable data to analyze (Brinkmann, 2014; Qu & Dumay, 2011). However, the biggest threat of interviews is about the potential bias of researchers, since researchers, as a critical role in interviews, may intentionally or deliberately commit bias (Qu & Dumay, 2011). For this reason, following highly structured procedures without deviations can minimize the potential researcher bias (Creswell, 2013).

In addition, experimental studies sometimes have a post-experimental interview at the end of an intervention (Christensen, Johnson, Turner, & Christensen, 2011). A post-experimental interview is often conducted under a debriefing procedure to inform the

participants about the true purposes and procedures of the research right after the research has been done (Christensen et al., 2011). To acknowledge the participants' reactions to the research, they are generally asked to tell their thoughts about the research. It can be used as a manipulation check by asking if they perceive the intervention and assessing their reactions.

For this study, a standardized questionnaire was verbally completed to measure residents' wellness (i.e., depression and quality of sleep). Two inventories, which are discussed in later section with details, were used, and the participants were asked to answer the same inventories twice, which were at the beginning and end of the intervention. At the conclusion of the experimental manipulation, as a post-experimental oral interview, four open-ended questions were asked to gain further descriptive feedback. The participants provided detailed responses about the intervention, any other experiences they might have, and the interior environments they like or want to improve in the facility, through the four open-ended questions.

Data Collection

This section will focus on a discussion about collecting data processes. The discussion covers, specifically, the two long-term care facilities participated, what types of samples (n=58) were recruited, which inventories were used to measure dependent variables (i.e., residents' wellness, such as depression and quality of sleep), and what types of interventions the participants received in what process.

Site Analysis

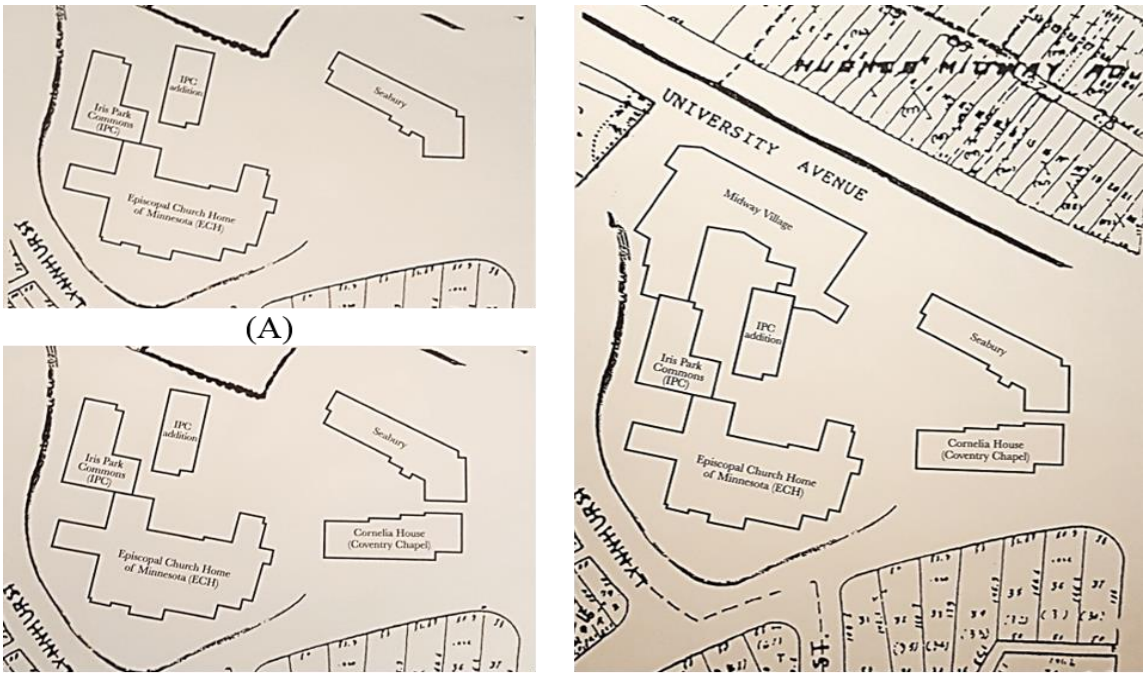
Long-Term Care Facility A

Long-term care facility A is located in St. Paul, Minnesota. The facility was founded as a non-profit organization in 1884 to provide homes and services to seniors. The whole facility consists of a range of senior living and care services in different buildings: transitional care, LTC/nursing home at two different buildings, assisted living, memory care, an independent living, affordable senior housing, and intergenerational child care center. Among these units, for this study, specifically, only the two LTC units from two different buildings (Building A and Building B) received the proposed intervention.

Figure 3. The bird view of the whole facility in 2018. Source from Episcopal Homes Website (www.episcopalhomes.org)

(A) (B)

Figure 4. (A) Layout of the facility in 1920, (B) Layout of the facility in 1971. Source from At Home in the City by Dave Kenney



(A) (B) (C)

Figure 5. (A) Layout of the facility in 2002, (B) Layout of the facility in 2005, (C) Layout of the facility in 2014. Source from At Home in the City by Dave Kenney

Figure 6. Single private bedroom with a private bathroom. Source from Episcopal Homes Website (www.episcopalhomes.org)

Since the foundation in 1884, the facility has had a number of renovations and new extension buildings. As Figure 4 shows, the facility has been developed based on a small part of Building B. By 1971, Building B finally took its present form of the building shape (see *Figure 4*). After several extensions, Building A was added to the facility (see *Figure 5*).

Building A has 60 beds, and Building B has 96 beds in total. The buildings are connected. All the rooms in both buildings are private bedrooms with a large window. The average age of residents is approximately 85. In these long-term care facilities, almost 50% of residents have cognitive impairment. Unlike other long-term care facilities, this long-term care facility emphasizes creating a sense of 'home' as much as possible. The facility has achieved this goal of creating home-like environments in many aspects. For example, all rooms are private rooms with basic furniture, such as a bed,

nightstand, and comfortable chair (see *Figure 6*). Because the rooms provide only basic furniture, residents are welcome to personalize their rooms by bringing their personal items (e.g., pictures, plants, lighting, etc.) and decorating their rooms. In addition, each unit has a kitchen, dining room, fireplace in a living room, and homey furnishings. Besides the interior environment, residents have flexible schedules for their routine lives and plenty of controls over their daily routines, such as choosing what they want to eat from the menus of various cafeterias and deciding when they want their meals.

Building A, which was built in 2014, is a seven-story building, consisting of the first floor for amenities with the rest six floors for long-term care units. Each floor has 10 beds, and its own kitchen, dining room, fireplace in living room. Building A, in particular, has been designed based on the Green House Project (Sharkey, Hudak, Horn, James, & Howes, 2011), the first such design in Minnesota. The project discovered that residents in conventional long-term care facilities are usually concerned about the lack of individualized attention, isolation, loneliness, the loss of independence, and the institutional atmosphere (Sharkey et al., 2011). By acknowledging these concerns among residents, the building design is intended to provide the most optimal care in a setting that is as close as possible to their real homes. As mentioned above, all rooms in Building B have its own private bathroom. Each room is approximately 225 square feet.

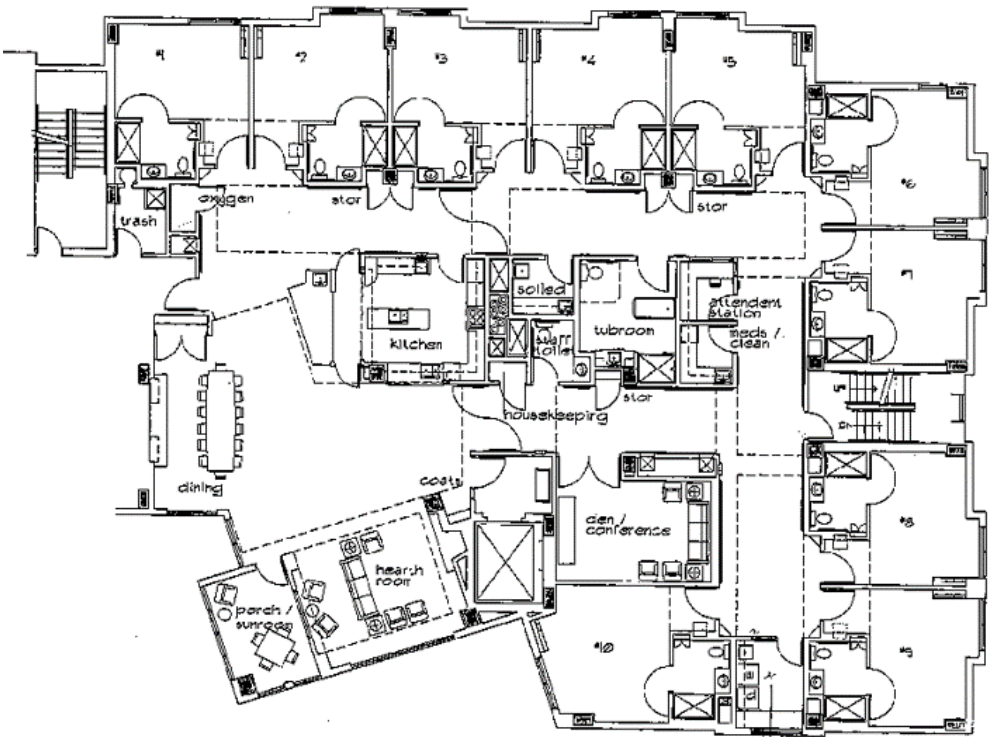


Figure 7. Floor plan of Building A

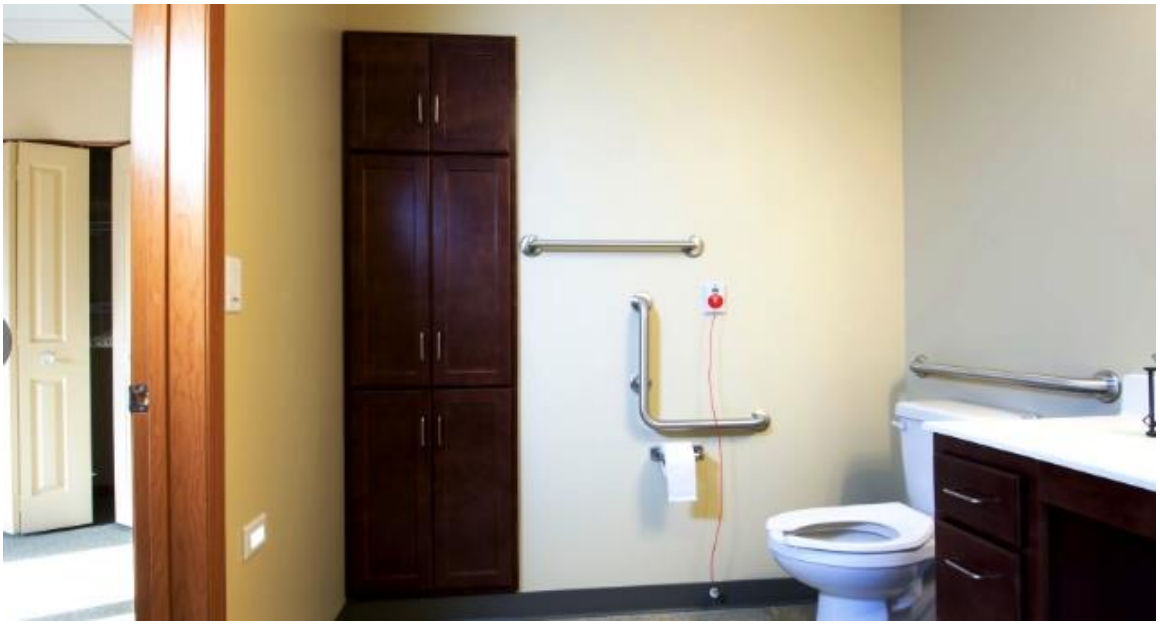


Figure 8. Private bathroom in a private bedroom. Source from Episcopal Homes Website (www.episcopalhomes.org)

Figure 9. Shared bathroom in hallways. Source from Episcopal Homes Website (www.episcopalhomes.org)

Figure 10. Exterior of Building A. Source from Episcopal Homes Website (www.episcopalhomes.org)

Figure 11. Exterior of Building B. Source from Episcopal Homes Website (www.episcopalhomes.org)

Building B has two stories, and there are three units per a floor. Each unit has from 12 to 18 beds, a living room with a fireplace, a dining room, and lounge spaces for visits with family. In particular, Building B is located at the corner of the whole campus; therefore, the environment is relatively quiet. In addition, Building B has a plenty of spaces where residents can always get fresh air and spend their time.

There are four courtyards within the building and an outdoor park for walks outside the building. Whereas all the rooms in Building A have identical rom layout (e.g., the same room size and a private bathroom), Building B has different room layouts. For example, the room size varies and 55 out of 95 bedrooms (around 60%) have a private bathroom, although all rooms are private bedrooms.

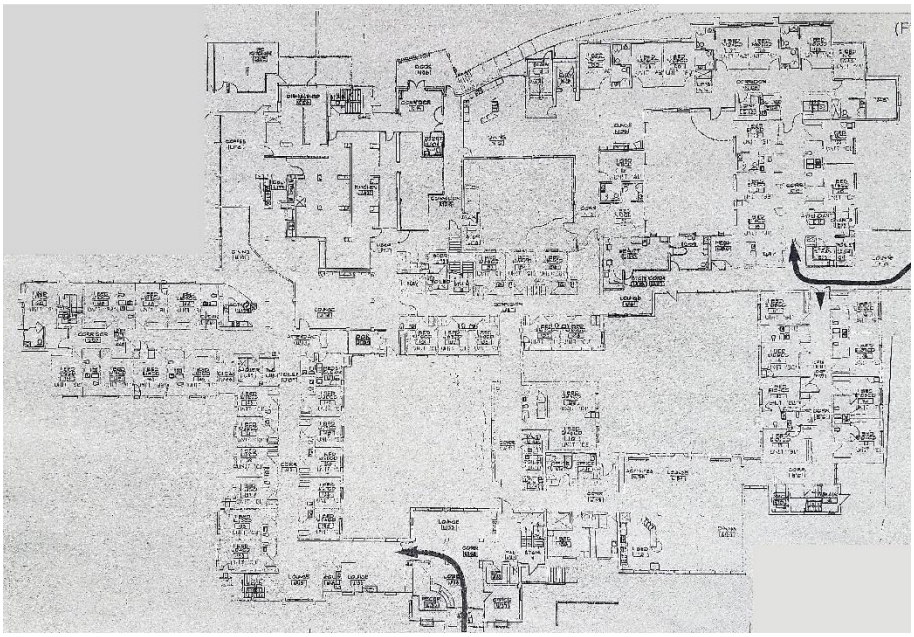


Figure 12. Floor plan of Building B

Figure 13. Living room in Building A. Source from Episcopal Homes Website (www.episcopalhomes.org)

Long-Term Care Facility B

Long-term care facility B is located in Minneapolis, Minnesota. The facility also consists of a range of senior living and care services in different buildings: rehabilitation

center, skilled nursing home/LTC, short-term care, and memory care. Among these units, only the LTC units from one building (Building C) received the proposed intervention.

Long-term care facility B has 140 beds in the entire facility and 102 beds in the LTC/nursing home unit. In the unit, there are 14 private rooms and 44 shared rooms. The private room is occupied by a sole person and has a bed, a drawer, and bathroom. On the other hand, the shared room is occupied by two people and has two beds, two drawer, and one bathroom. All the rooms also have a large window. The average age of residents is approximately 81.

Figure 14. Building facade of Building C in long-term care facility B

Figure 15. Hallway in Building C

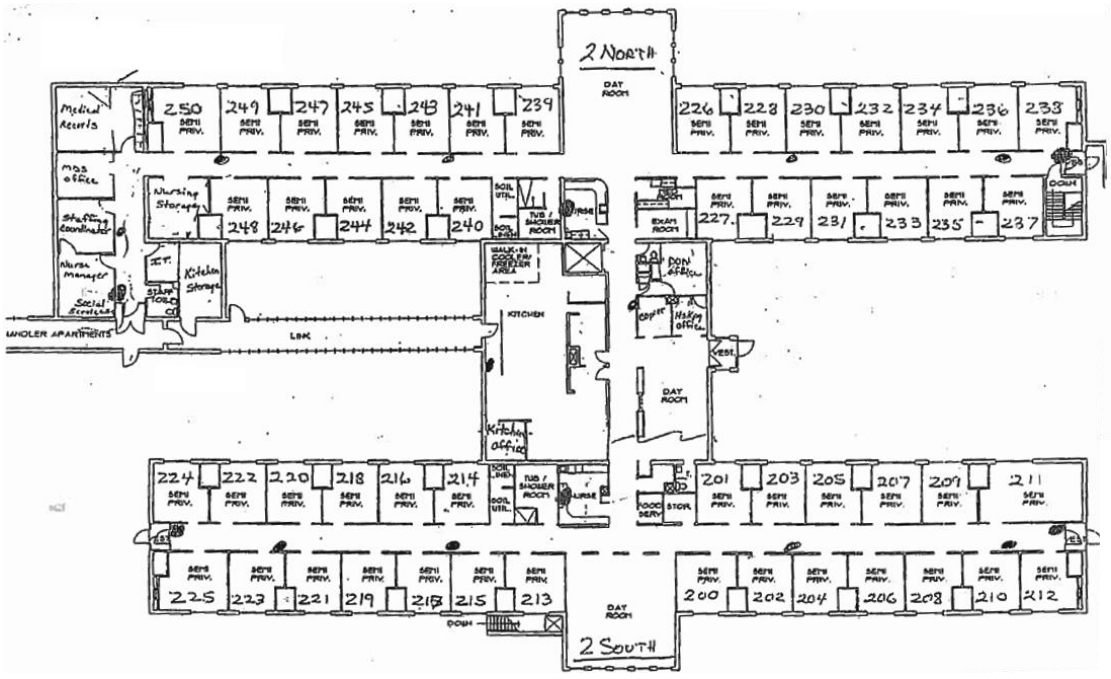


Figure 16. Floor plan of Building C

Building C has two stories. Each unit has a living room with a fireplace, a dining room, and lounge spaces for visits with family. In addition, Building C has a couple of garden spaces where residents can take a walk in the fresh air and relax.

Participants

Residents in both long-term care facilities (i.e., three different building in two long-term care facilities) were recruited. There were five inclusion criteria for this study (Table 4). One of the inclusion criteria for the study was that residents must have stayed at the facility for at least one month so that they had been fully exposed to the environment. The second inclusion criterion was that residents must be cognitively able to properly understand and consent to the study. This inclusion criterion was determined by the staff from each nursing facility. The third exclusion criterion was residents having any problems with their olfactory system (e.g., cannot smell scent) and residents taking any medications (e.g., medications for depression or sleep aid) for the past two weeks. To be specific, when recruited, residents were asked to smell a jar of one ounce of carrier oil with six drops of essential lavender oil and to describe the scent. Once the residents provided an answer that suggested lavender (e.g., flower, something sweet, etc.), they were included in the study as potential participants. In addition, the staff also excluded any residents who had taken any meditation for depression or sleep based on their medical records. Lastly, if residents received a higher score than 10 in the Geriatric Depression Scale (GDS) at baseline, the residents were excluded from the study due to ethical issues.

Table 4.

Inclusion Criteria

1. At least one month stay
2. Cognitively availability based on nursing staff's screening
3. No problem with olfactory system based on screening
4. No medication on depression and sleep aid
5. Less than 10-point score in the Geriatric Depression Scale (GDS)

For this study, a total of 58 residents (18 residents from Building A, 20 residents from Building B, and 20 residents from Building C) were recruited. The anticipated number of participants for this study was at least 58 participants to get statistically powerful results based on an effect size of =0.74 (Karadag et al., 2017), power of .80, alpha of .05, and minimum detectable effect of 2.0 (Djimeu & Houndolo, 2016). Out of 257 residents from two long-term care facilities (155 residents at Long-Term Care Facility A and 102 residents at Long-Term Care Facility B), 168 residents were excluded because they did not meet more than one of the top four criteria listed in Table 4. In addition, despite meeting all the four criteria, 29 residents declined to participate. Lastly, one more resident was excluded because the resident's baseline score on GDS was above 10 out of 15 points.

Table 5 describes the 58 residents recruited for this study. Out of 58 residents, 38 residents participated in the study from Long-Term Care Facility A, 18 residents at Building A and 20 residents at Building B, respectively. The remaining 20 residents were recruited from Long-Term Care Facility B. All residents from Long-Term Care Facility A live in a private room. On the other hand, two residents from Long-Term Care Facility B live in a private room and eight residents live in a shared room without a roommate. The

other ten residents from Long-Term Care Facility B live in a shared room with a roommate. However, in this study, none of the participants in this study were roommates. In other words, the ten residents who had a roommate in a shared room were the only participants in their room.

Table 5

Demographic Information about the Participants (N=58)

		Long-Term Care A		Long-Term Care B	
		Building A	Building B	Building C	Total
		N (%)	N (%)	N (%)	N (%)
Gender	Female	13 (30.2%)	14 (32.6%)	16 (37.2%)	43 (100%)
	Male	5 (33.3%)	6 (40.0%)	4 (26.7%)	15 (100%)
Room	Private room	18 (45.0%)	20 (50.0%)	2 (5.0%)	40 (100%)
	Shared room but no roommate	0 (0%)	0 (0%)	8 (100%)	8 (100%)
	Shared room with a roommate	0 (0%)	0 (0%)	10 (100%)	10 (100%)
		M (SD)	M (SD)	M (SD)	M (SD)
Age (year)		86.9 (6.7)	81.0 (8.6)	81.0 (12.9)	82.8(10.0)
Ventilation (feet)		8.00 (0.0)	6.7 (0.5)	8.6 (1.7)	7.7 (1.3)
SF (feet^2)		206 (0.0)	194 (26)	225 (0.0)	209 (20)

In this study, more female residents participated than male residents, and the average of age of all the residents was 82.8 years. The distance between a ventilation system/fan and the location of a glass jar was measured. Each room at Building A and Building C has a ventilation system/fan in a bathroom. At Building B, the air exchange system was in the wall connecting the bathroom. The average distance between a ventilation and the glass jar location was 7.7 feet. In addition, the square footage of each room was also measured based on the floor plan, provided by the nursing facility; and the average size was 209 feet^2.

Intervention

In this study, there was one intervention, which was the ambient scent environment providing olfactory stimulation. Residents were exposed to one of two groups: 1) placebo (control), and 2) intervention group. All other care and procedures that the residents in long-term care facilities receive remained the same, but the olfactory stimulation in the ambient scent environments was only different. The following section will discuss the intervention in detail.

Ambient Scent Environment Intervention for Olfactory Stimulation

During the ambient scent environment intervention period, 100% essential oils (Nature's Truth, Ronkonkoma, NY) was used. To create an ambient scent environment providing olfactory stimulation, a 2-ounce small jar with six reed sticks (see *Figure 17*) was placed at the bedside of each resident between 12 and 18 inches away from the side of the bed. According to the formula for dilution from the National Association for Holistic Aromatherapy, 1-ounce carrier oil and 5 drops of lavender essential oil was used to make a 1% dilution, based on guidelines to dilute essential oils (Worwood & Worwood, 2012). For the elderly, the recommended dilution for environmental inhalation is less than 2%. The aroma typically lasts about three to four weeks, depending on room size, ventilation, fans, humidity, heating, closed doors, open doors, air conditioning, etc. (Tisserand & Young, 2013).

Figure 17. A 2-ounce glass jar with reed sticks, which used for this study.

For the placebo group, instead of aromatic oil, only carrier oil which is a non-scented oil (i.e., grapeseed oil) was added to a 2-ounce glass jar with six reed sticks. Like the intervention group, the jar was placed at the bedside of each resident between 12 and 18 inches away from the side of the bed. To use the jar with reed sticks and diffuse more effectively in indoor environment, the reed sticks could be simply flipped once a week if needed.

Measurements for Anxiety and Depression

As dependent variables for this study, the perceived level of depression and quality of sleep were measured through two different inventories (i.e., Geriatric Depression Scale—Short Form, and Pittsburg Sleep Quality Index). Both inventories are self-administrated reports, and the participants completed verbally the questionnaires at the beginning and the end of the intervention. This section will discuss the two inventories in detail.

Geriatric Depression Scale—Short Form

The original version of the Geriatric Depression Scale (GDS), as a brief self-report questionnaire, consists of 30 questions with yes or no scale to measure depressive symptoms among the elderly (Brink et al., 1982; Yesavage et al., 1983). A short version which consists of 15 questions with yes or no scale is also available (Yesavage & Sheikh, 1986). The GDS is specially designed for the elderly, and it includes questions about depression in the mood (e.g., sadness and apathy) and cognitive domains (e.g., helplessness, hopelessness, and worthlessness), but no somatic domain (e.g., appetite and sleep) (Smarr & Keefer, 2011). For the recall period, the original form of the GDS is used for asking participants about the current state, and the shorter form is used for asking participants about state of the past week. For scoring, the total score from the questions will be calculated. In the original form, a score between 0 and 9 is interpreted as normal, a score between 10 and 19 as mild depression, and a score between 20 and 30 as severe depression. In the short form, a score between 0 and 5 is interpreted as normal, a score between 5 and 10 as mild depression, and a score between 10 and 15 as severe depression (Smarr & Keefer, 2011).

From its previous applications in diverse settings, a good internal consistency (i.e., Cronbach's alpha) has been found for the GDS using both oral and written applications, ranging from .69 to .99 for the original form (Lopez, Quan, & Carvajal, 2010) and from .74 to .86 for the short form (Friedman, Heisel, & Delavan, 2005; Van Marwijk et al., 1995). The inventory also has a good test-retest reliability (r = .85) (Smarr & Keefer, 2011). In addition, a high level of validity has been demonstrated by showing

high levels of correlations with other instruments, such as the Zung Self-Rating Scale for Depression and the Hamilton Rating Scale for Depression, ranging from .83 to .84 (Yesavage et al., 1983). The GDS also has high sensitivity as well as specificity. The short form, especially has a sensitivity of .81 and a specificity of .78 (Van Marwijk et al., 1995).

The biggest strength of the GDS is that provides a simple format to study accurately and effectively depressive symptoms among the elderly, even older than 85 years (Smarr & Keefer, 2011). For this study, the short form of GDS was used to increase focus in the elderly (Yesavage & Sheikh, 1986), considering the fact that the average age of the population was approximately 83.

Pittsburg Sleep Quality Index—Modified Version

The Pittsburg Sleep Quality Index (PSQI) is developed to measure sleep quality retrospectively through a range of domains, including duration of sleep, wake patterns, sleep-related problems, etc. (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The PSQI has 19 items, which can be categorized into seven groups with equally weighted scores: 1) subject sleep quality (1 item); 2) sleep latency (2 items); 3) sleep duration (1 item); 4) habitual sleep efficiency (3 items); 5) sleep disturbances (9 items); 6) use of sleeping medication (1 item); and 7) daytime dysfunction (2 times) (Smith & Wegener, 2003). The PSQI is also a brief self-reported questionnaire. The original purpose of the PSQI was to distinguish good sleepers from bad sleepers, and it has been used and validated in a broad range of populations, including older adults (Buysse et al., 1991; Smith & Wegener, 2003). The recall period for the PSQI is a month. The score can be

calculated with the seven groups, which can be scored from 0 to 3. Therefore, a total score can be up to 21, and a total score over 5 is interpreted as the respondent having sleep difficulties. However, the cutoff score of 8 instead of 5 has been suggested to have higher sensitivity and specificity for certain populations (Carpenter & Andrykowski, 1998).

The PSQI has a high internal consistency, which can be represented as Cronbach's alpha coefficient of .83, as well as a high test-retest reliability (r = .85) (Buysse et al., 1989). The PSQI also has a high sensitivity of .89 as well as a good specificity of .86 (Smith & Wegener, 2003). As the most popular and widely used measurement for sleep quality with translations into 48 different languages, the PSQI covers a broad range of domains associated with sleep quality in a brief form (Buysse et al., 2008; Smith & Wegener, 2003). However, the recall period of a month can easily generate recall bias. In addition, some questions are difficult to answer accurately. For example, having trouble sleeping due to loud snore may not be noticed by the participant.

For this study, the recall period was adjusted to two weeks, because the intervention lasted for two weeks. This means that once the participants respond to the PSQI at the beginning of the study, they were asked the same inventory again two weeks later. In addition, the question about taking medicine for sleep aid was eliminated, because one of the exclusion criteria is taking sleep aid medication. Therefore, a modified version of PSQI was used for this study.

Procedures

Out of 257 residents, the total of 58 residents participated in this study by signing on the consent form and they were randomly assigned to one of two groups (i.e., placebo and intervention group). The detailed steps for random group allocation are described in Figure 18. First of all, residents were screened based on the inclusion and exclusion criteria. For example, they were screened whether they are cognitively able to understand and participate in the study. Residents with cognitive availability were identified by nurses in the facility who know the residents well. They were also screened whether their olfactory systems work and whether they take any medication for depression and sleep aid. Once they were screened, they were asked to verbally respond to a first set of two questionnaires (GSD—Short form and PSQI—Modified Version), if they consented to participate in the study.

Once the baseline data was collected, the 58 residents were randomly assigned into either a placebo or intervention group. Since participants were recruited from two different long-term care facilities and three different buildings, and the room size and distance between a ventilation system and a bed differs. Therefore, before randomization, the participants were stratified into gender, three buildings, and the room size. By applying stratified randomization, the placebo and intervention groups can be compared with regard to those stratified characteristics (Kernan, Viscoli, Makuch, Brass, & Horwitz, 1999). Age was not used for stratification because both long-term care facilities have the similar average age (from 81 to 87 years-old).

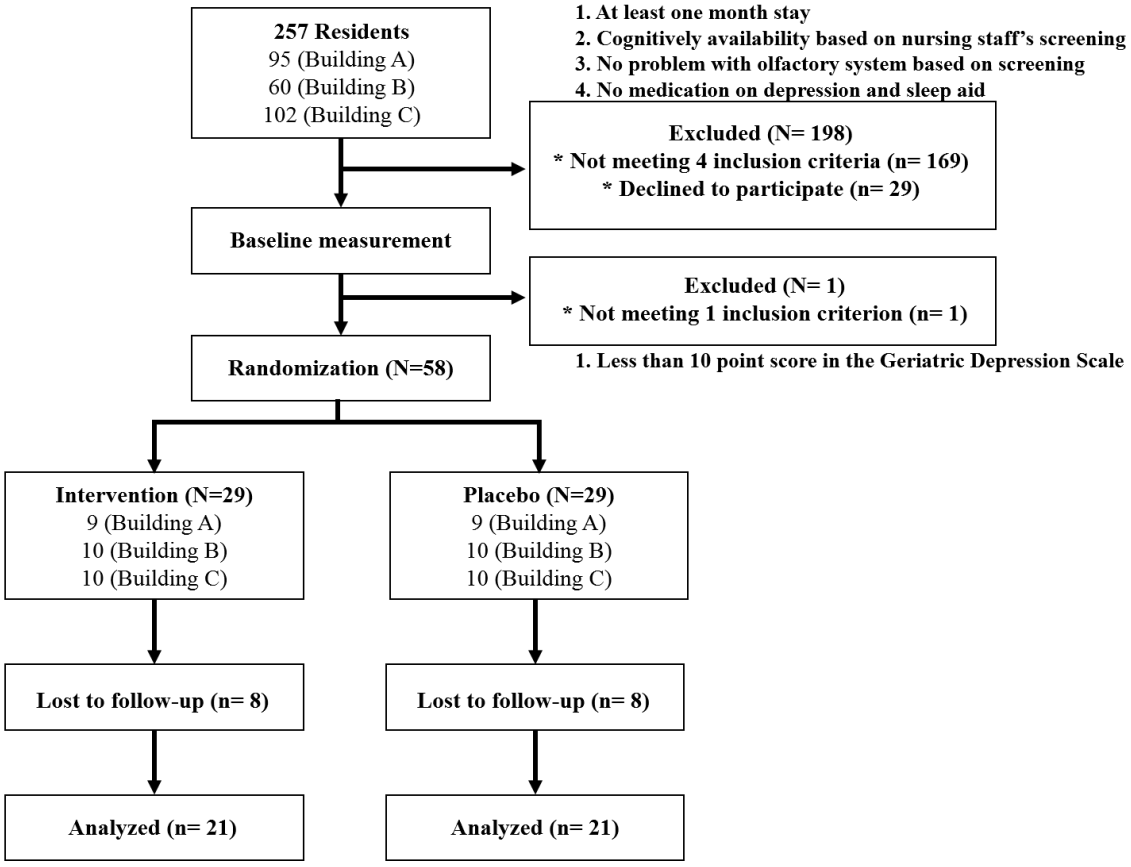


Figure 18. Recruitment and data analysis process

After the stratified randomization, the ambient scent environmental intervention providing olfactory stimulation was introduced. The intervention period was two weeks. Two weeks later, the participants were asked to verbally answer again consisting of GSD—Short form, PSQI—Modified Version, and four additional open-ended questions as the post-experimental interview.

Data Analysis

Once the data was collected, it was screened for missing value. During the two-weeks of intervention, 16 residents were lost for follow-up (8 residents in the intervention group and 8 residents in the placebo group). Anyone who dropped the study or missed the

follow-up questionnaire was treated as missing data. To be specific, two residents did not want to put the jar next to their bedside anymore, six residents did not follow the instructions (e.g., change the location away from their bed side), and eight residents took medication for depression or sleep during the intervention period.

To treat missing value, there are two big main methods, which are intention-to-treat (ITT) and pre-protocol (PP) (Dziura, Post, Zhao, Fu, & Peduzzi, 2013). While ITT includes all participants who are randomized and measured for the baseline, PP only includes participants with no missing data (Gupta, 2011). For this reason, as known as "once randomized, always analyzed", ITT retains the original number of participants regardless of non-compliance or withdrawal, whereas PP can have a decreased final number of participants (Gupta, 2011). Therefore, ITT is considered as the gold standard in RCTs in terms of keeping the same number of participants to have stronger statistical power (Heritier, Gebski, & Keech, 2003).

There are a number of ways to impute missing values, including last observation carried forward (LOCF), simple and conditional mean imputation, and regression imputation (Dziura et al., 2013). LOCF, one of the most frequently used imputation methods, replaces missing values with the last observed value within the participant (Kang, 2013). It is easy to apply by strongly assuming the outcome values, but it may introduce bias by underestimating possible variability (Dziura et al., 2013). Another imputation method is substituting missing values with the mean value of a variable. However, this method can be problematic because it may distort the relationships by assuming that the variable would have a normal distribution and by underestimating the

standard deviation (Donders, van der Heijden, Stijnen, & Moons, 2006; Dziura et al., 2013).

Lastly, the missing values can be replaced with the estimated values by regressing the outcome on all observed data. This method considers a random error component by using the regression equation and avoids significant changes in the standard deviation or the distribution (Kang, 2013). However, problems with using the modeled (i.e., regression) imputation include overestimating the regression model fit as well as increasing correlation coefficient (Dziura et al., 2013). In addition, like mean substitution, it can underestimate any variance among the variable (Kang, 2013). For this study, no imputation was conducted; therefore, only the data completed both baseline and follow-up was analyzed.

Finally, to answer the research questions for this study, the quantitative data was analyzed by using SPSS Statistics 25 (Armonk, NY: IBM Corp). As mentioned earlier, out of 58 residents, ten residents live in a shared room with a roommate (who did not participate in this study) and the rest of the 48 residents lived in either a private room or a shared room without a roommate. Therefore, both the entire dataset, including all participating residents, (n=58) and the subset of participants without roommates (n=48) were further analyzed. T-tests were used to explore the effectiveness of the ambient scent intervention providing olfactory stimulation between the placebo and intervention groups. As t-tests tell whether two averages are different each other by comparing them and how the differences are significant (Lock, Lock, Morgan, Lock, & Lock, 2013), the differences in dependent variables between two groups and within the groups can be

analyzed by the t-test. For example, the baseline data from the two groups were analyzed to see whether there were any significant differences in depression and quality of sleep. After the intervention, the follow-up data from the two groups were also analyzed to see any differences in those two dependent variables. The t-test can also be used to compare the baseline data to the follow-up data within each group to find any differences. As effect modifiers, the different buildings, distance to the ventilation system, and the different room size (i.e., different square footage) were analyzed as an interaction effect to see their influences on the dependent variables in regression analyses. Due to high changes of multicollinearity for the interaction terms, regression analyses were reported with variance inflation factors (VIF). Mean centering method was used for all the interaction terms in regression analyses to alleviate VIF greater than 10 which threat collinearity (Mason & Perreault Jr, 1991). In addition, the qualitative data was analyzed by using NVivo 12 (Version 12. QSR International, 2018).

RESULTS

This chapter will discuss the results of data analyses. As mentioned in the previous chapter, two different datasets were analyzed. The first dataset (n=58) included all 58 residents who participated in the study. The second dataset (n=48) excluded the ten residents who lived in a shared room with a roommate. In other words, the second dataset only included the residents who lived in a room by herself/himself. For data analysis, the categorical variables (i.e., intervention group and gender) were coded as following: intervention group and female were coded as 1 (one), and the placebo group and male were coded as 2 (two). To answer the research questions, both quantitative and qualitative data analyses were used.

The Entire Participants

The demographic information describing the two groups in the first dataset is summarized in Table 6. The demographics (e.g., gender and age) and the built environment (e.g., building, room type per building, distance to a ventilation system, and square footage) were not statistically different in comparing the two groups. These results showed that the 58 residents were evenly distributed to either the intervention or placebo group through the stratified randomization.

Normality of the main variables was also tested via Shapiro-Wilk because the sample size is larger than seven but smaller than 2,000 (Park, 2015). Given that $p = 0.27$ for baseline GDS, $p = 0.15$ for follow-up GDS, $p = 0.06$ for changes in GDS, $p = 0.11$ for baseline PSQI, and $p = 0.29$ for follow-up PSQI, all the main variables, except for changes in PSQI ($p = 0.04$), were normally distributed. As a part of verifying regression

assumptions, not only normality, but also linearity, independency, and homogeneity of variance were also examined prior to regression analyses. To be specific, scatterplots were used to examine linearity, and Durbin-Watson tests were conducted to check independency of variances. A value between 1.5 and 2.5 was interpreted as independent variances because a value closer to 0 indicates a positive autocorrelation and a value closer 4 represents a negative autocorrelation among variances (Durbin & Watson, 1950). Lastly, homogeneity of variance was checked through variance scatter dots falling between -2 and +2 not in any specific pattern.

Table 6

Demographic Information about Two Groups (n=58)

		Intervention (N=29)		Placebo (N=29)			
		N	%	N	%	x^2	
Gender	Female	21	72.4	22	75.9	0.09	
	Male	8	27.6	7	24.1		
Building	Building A (Long-Term Care A)	9	50.0	9	50.0	0.00	
	Building B (Long-Term Care A)	10	50.0	10	50.0		
	Building C (Long-Term Care B)	10	50.0	10	50.0		
Room	No roommate in Building A	9	50.0	9	50.0	0.00	
	No roommate in Building B	10	50.0	10	50.0		
	No roommate in Building C	5	50.0	5	50.0		
	Roommate in Building C	5	50.0	5	50.0		
		M	SD	M	SD	ΔM	*t*
Age (year)		81.24	11.05	84.46	9.00	3.22	1.21
Ventilation (ft)		7.66	1.35	7.79	1.31	0.14	0.40
SF (ft^2)		205.93	22.77	211.14	16.36	5.21	1.00

* $p<0.05$, ** $p<0.01$

Table 7 describes correlations among the variables in this study. Baseline GDS refers to the GDS score a resident receives at a baseline, and the follow-up GDS refers to the GDS score a resident received at the follow-up visit. Change in GDS is the differences in GDS score between baseline and follow-up. The variables regarding PSQI follow the same logic with PSQI score instead of GDS score. Baseline GDS had moderate and positive correlations with follow-up GDS ($r = 0.42$, $p < 0.01$) and change in GDS ($r = 0.53$, $p < 0.01$). Baseline GDS also had a very weak and negative correlation with baseline PSQI ($r = -0.03$, $p < 0.05$). Follow-up GDS had a moderate and negative correlation with change in GDS ($r = -0.55$, $p < 0.01$).

Similar to GSD, baseline PSQI also had moderate and positive correlations with follow-up PSQI ($r = 0.48$, $p < 0.01$) and change in GDS ($r = 0.55$, $p < 0.01$). Again, follow-up PSQI also had a moderate and negative correlation with change in PSQI ($r = -0.47$, $p < 0.01$). Distance to a ventilation system from a resident's bed had a moderate and positive correlation with square footage ($r = 0.54$, $p < 0.01$).

Table 7

Pearson Correlation Among Variables (N=58)

	Baseline GDS	Follow-up GDS	Change in GDS	Baseline PSQI	Follow-up PQSI	Change in PSQI	Ventilation	SF	Gender	Age
Baseline GDS	-									
Follow-up GDS	0.42**	-								
Change in GDS	0.53**	-0.55**	-							
Baseline PSQI	-0.03*	-0.06	-0.30	-						
Follow-up PSQI	-0.25	-0.07	-0.17	0.48**	-					
Change in PSQI	-0.14	0.00	-0.14	0.55**	-0.47**	-				
Ventilation	-0.20	-0.05	-0.14	-0.02	0.01	0.09	-			
SF	-0.15	-0.08	-0.10	0.09	-0.14	0.06	0.54**	-		
Gender	-0.04	0.08	0.00	-0.36	-0.15	-0.11	0.00	-0.05	-	
Age	0.06	0.21	-0.31*	0.10	-0.22	0.15	0.07	0.12	-0.34**	-

* $p<0.05$, ** $p<0.01$

Depression

RQ 1. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' depression in long-term care facilities?

To answer RQ 1, a series of *t*-tests were conducted. First of all, Table 8 describes the independent *t*-tests that were conducted to compare group differences in GDS scores at both baseline and follow-up stages. The results indicated that there was no difference in GDS at baseline [$t(56) = 0.83$, p = n.s.] and follow-up [$t(40) = 0.79$, p = n.s.] between the intervention and placebo group.

Table 8

Independent t-tests to Compare Group Differences in GDS at Baseline and Follow-up Stages

	Intervention		Placebo			
	M	SD	M	SD	ΔM	*t*
Baseline (N=58)	4.59	2.13	5.03	1.97	0.45	0.83
Follow-up (N=42)	3.14	2.06	3.62	2.01	0.48	0.79

* $p<0.05$, ** $p<0.01$

Table 9 describes the paired samples *t*-tests that were conducted to compare GDS scores at baseline and follow-up for each group. The results showed that both the intervention and placebo groups had a statistically significant difference in GDS at follow-up from baseline. To be specific, the intervention group had significantly lower GDS at follow-up (M = 3.14, SD = 2.06) than at baseline (M = 4.19, SD = 1.83), $t(20) = 2.18$, $p < 0.05$). The placebo group also had a significantly lower GDS at follow-up (M = 3.62, SD = 2.01) than at baseline (M = 5.19, SD = 2.06), $t(20) = 3.34$, $p < 0.05$). Interestingly, as the results showed, the placebo group (ΔM = 1.57) had a bigger

difference in GDS between baseline and follow-up than the intervention group (ΔM = 1.05).

Table 9

Paired Samples t-tests to Compare Differences in GDS at Baseline and Follow-up

	Baseline		Follow-up			
	M	SD	M	SD	ΔM	*t*
Intervention (N=21)	4.19	1.83	3.14	2.06	1.05	2.18 *
Placebo (N=21)	5.19	2.06	3.62	2.01	1.57	3.34 **

* $p<0.05$, ** $p<0.01$

To explore a moderation effect of intervention group on the association of depression scores, additional regression analyses were conducted. Table 10 shows the estimates of the associations between two predictors (i.e., baseline GDS and intervention) and follow-up GDS (Model 1) as well as an interaction term of baseline GDS and intervention (Model 2). While Model 1 was statistically significant and explained 13% of the variance (*Adjusted* $R^2 = 0.13$, $F(2, 39) = 4.11$, $p < 0.05$), Model 2 was not statistically significant (*Adjusted* $R^2 = 0.11$, $F(2, 39) = 2.67$, p = n.s.). In addition, in Model 2, only baseline GDS statistically predicted follow-up GDS ($\beta = 0.42$, $p < 0.05$). This result indicated that the intervention had no measurable effect on depression (see Figure 19).

Table 10

Hierarchical Regression Analyses Showing the Moderation Effect of Intervention Group on the Relationship Between Baseline GDS and Follow-up GDS

	Model 1				Model 2			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.42**	0.15	2.75	1.07	0.42*	0.16	2.68	1.08
Intervention	0.06	0.60	0.09	1.07	0.06	0.61	0.09	1.07
B_GDS*Intervention					0.02	0.31	0.07	1.02
Constant	1.33	1.04	1.28		1.33	1.06	1.28	
F	4.11*				2.67			
Adjusted R^2	0.13				0.11			
Δ *Adjusted* R^2	-				-0.02			

Note. B_GDS: baseline GDS
* $p<0.05$, ** $p<0.01$

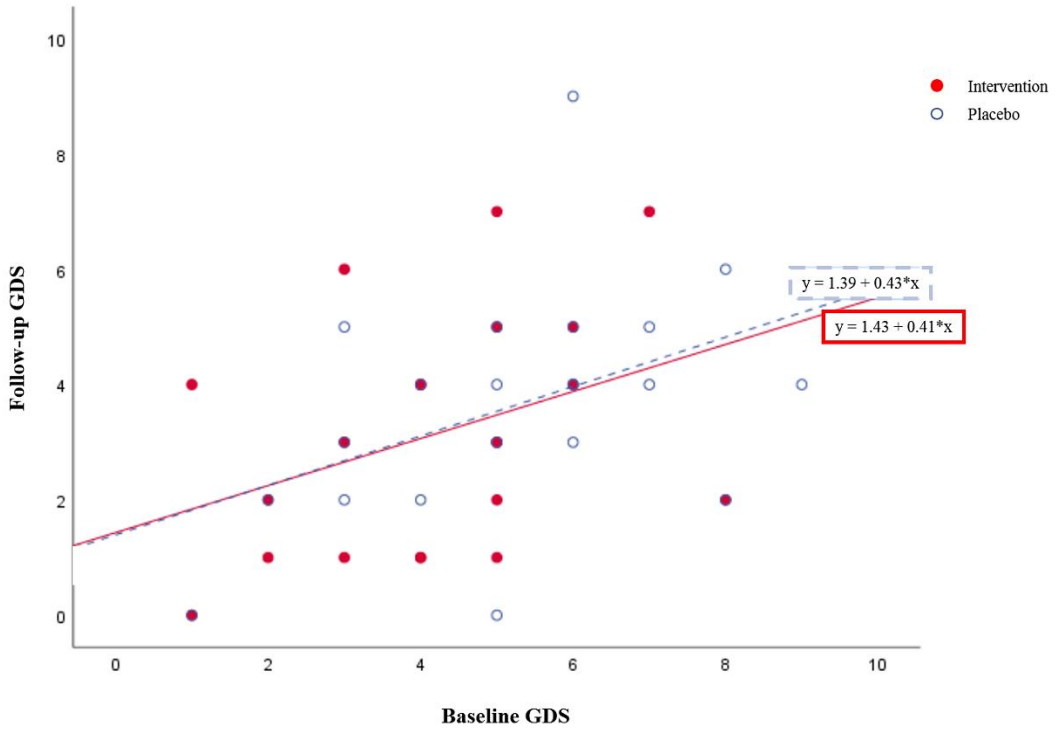


Figure 19. Two groups' regression lines showing the relationship between baseline GDS and follow-up GDS

RQ 1.1. As effect modifiers, do a distance to a ventilation system, SF, and building in which participant reside affect changes in residents' depression in long-term care facilities s?

To explore the moderation impact of intervention groups on the association between other variables (i.e., distance to a ventilation system, SF, and building) and changes in GDS, additional regression analyses were conducted. Table 11 shows the estimates of the associations among major predictors (i.e., baseline GDS, intervention), each effect modifier (i.e., distance to a ventilation, SF, and building) and changes in GDS (Model 1, 4, and 7) as well as the interaction terms of intervention and baseline GDS (Model 2, 5, and 8) and each effect modifier (Model 3, 6, and 9).

Regarding the effect of a distance to a ventilation system from a bed, the three models (Models 1, 2, and 3) were all statistically significant; however, Model 1 (*Adjusted* $R^2 = 0.23$, $F(3, 38) = 4.98$, $p < 0.01$) had a slightly higher ability to explain the variance than Model 2 (*Adjusted* $R^2 = 0.21$, $F(4, 37) = 3.64$, $p < 0.05$) and Model 3 (*Adjusted* $R^2 = 0.22$, $F(5, 36) = 3.25$, $p < 0.05$). Again, only baseline GDS statistically predicted changes in GDS in three models, and the results indicated no measurable effect of i the interaction between baseline GDS and ventilation on changes in depression.

Similarly, three hierarchical regression analyses were conducted to examine the effect of SF on changes in depression. Although the three models (Models 4, 5, and 6) were all statistically significant, Model 4 (*Adjusted* $R^2 = 0.23$, $F(3, 38) = 4.96$, $p < 0.01$) had a slightly higher ability to explain the variance than Model 5 (*Adjusted* $R^2 = 0.20$, $F(4, 37) = 3.62$, $p < 0.05$) and Model 6 (*Adjusted* $R^2 = 0.18$, $F(5, 36) = 2.83$, $p < 0.05$).

Again, only baseline GDS statistically predicted changes in GDS in the three models, and the results indicated no measurable effect of the interaction between baseline GDS and SF on changes in depression.

Lastly, the moderation impacts of the intervention groups on the association between the different buildings and changes in GDS were examined. The Models 7, 8, and 9 were all statistically significant, but Model 7 (*Adjusted* R^2 = 0.25, F(4, 37) = 4.39, $p < 0.01$) explained the variance slightly more than Model 8 (*Adjusted* R^2 = 0.24, F(6, 36) = 3.52, $p < 0.05$) and Model 9 (*Adjusted* R^2 = 0.20, F(7, 34) = 2.49, $p < 0.05$). However, only baseline GDS was statistically able to predict the changes in GDS.

Table 11

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline GDS and Follow-up GDS

Ventilation effect	Model 1				Model 2				Model 3			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.57**	0.16	3.59	1.14	0.57**	0.16	3.48	1.18	0.51**	0.17	3.02	1.28
Intervention	-0.03	0.62	-0.05	1.10	-0.03	0.63	-0.05	1.12	0.14	0.64	0.22	1.18
Ventilation	-0.05	0.24	-0.22	1.08	-0.05	0.25	-0.21	1.16	-0.08	0.25	-0.34	1.17
B_GDS*Intervention					0.00	0.33	0.00	1.10	0.12	0.34	0.36	1.20
Ventilation*Intervention									0.61	0.49	1.23	1.17
Constant	-0.93	2.09	-0.44		-0.93	2.16	-0.43		-0.75	2.15	-0.35	
F	4.98**				3.64*				3.25*			
Adjusted R^2	0.23				0.21				0.22			
Δ *Adjusted* R^2	-				-0.02				-0.01			
SF effect	Model 4				Model 5				Model 6			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.58**	0.16	3.65	1.14	0.59**	0.17	3.56	1.18	0.59**	0.17	3.48	1.23
Intervention	-0.07	0.62	-0.10	1.23	-0.07	0.64	-0.11	1.15	-0.09	0.66	-0.14	1.19
SF	0.00	0.14	0.06	1.10	0.00	0.15	0.08	1.17	0.00	0.15	0.34	1.24
B_GDS*Intervention					-0.03	0.33	-0.08	1.10	-0.08	0.34	-0.12	1.15
SF*Intervention									0.00	0.03	-0.17	1.23
Constant	-1.50	3.08	-0.49		-1.56	3.19	-0.49		-0.75	3.34	-0.42	
F	4.96**				3.62*				2.83*			
Adjusted R^2	0.23				0.20				0.18			
Δ *Adjusted* R^2	-				-0.03				-0.05			

Note. B_GDS: baseline GDS

* $p<0.05$, ** $p<0.01$

Table 11 (Continue)

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline GDS and Follow-up GDS

Building effect	Model 7				Model 8				Model 9			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.58**	0.15	3.73	1.09	0.59**	0.16	3.74	1.13	0.60**	0.17	3.53	1.27
Intervention	-0.03	0.60	-0.05	1.07	-0.06	0.61	-0.10	1.08	-0.12	0.63	-0.18	1.11
Building 1	-1.05	0.74	-1.42	1.39	-1.19	0.79	-1.52	1.54	-1.23	0.81	-1.52	1.56
Building 2	-0.78	0.71	-1.10	1.41	-0.88	0.74	-1.20	1.50	-0.94	0.76	-1.24	151
B_GDS*Intervention					-0.19	0.33	-0.57	1.14	-0.24	0.34	-0.70	1.19
Building 1*Intervention									0.05	1.62	0.33	1.56
Building 2*Intervention									0.97	1.51	0.64	1.51
Constant	-0.74	1.11	0.66		-0.61	1.15	-0.53		-0.57	1.18	-0.48	
F	4.39**				3.52*				2.49*			
Adjusted R^2	0.25				0.24				0.20			
Δ *Adjusted* R^2	-				-0.01				-0.05			

Note. B_GDS: baseline GDS
* $p<0.05$, ** $p<0.01$

In conclusion, no statistically significant impact of effect modifiers on changes in GDS was found. Additional regression analyses were conducted by adding the control variables (i.e., gender and age) to each model. The results were consistent, indicating baseline GDS as the only statistically significant predictor of changes in GDS.

Quality of Sleep

RQ 2. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' perceived quality of sleep in long-term care facilities?

To answer RQ 2, a series of *t*-tests were conducted. First of all, Table 12 describes the independent *t*-tests that were conducted to compare group differences in PSQI scores at both baseline and follow-up stages. The results indicated that there was no difference in PSQI at baseline [$t(56) = 0.76$, p = n.s.] and follow-up [$t(40) = 0.65$, p = n.s.] between the intervention and placebo group.

Table 12

Independent t-tests to Compare Group Differences in PSQI at Baseline and Follow-up Stages

	Intervention		Placebo			
	M	SD	M	SD	ΔM	*t*
Baseline (N=58)	6.62	2.65	6.07	2.70	0.55	0.76
Follow-up (N=42)	5.81	2.18	5.19	3.03	0.52	0.65

* $p<0.05$, ** $p<0.01$

Table 13 describes the paired samples *t*-tests that were conducted to compare PSQI scores at baseline and follow-up for each group. The results showed that only the intervention group had a statistically significant difference in PSQI at follow-up from

baseline. To be specific, the intervention group had a significantly lower PSQI at follow-up (M = 5.81, SD = 2.18) than at baseline (M = 7.14, SD = 2.53), $t(20) = 2.43$, $p < 0.05$, $\Delta M = 1.33$). On the other hand, the placebo group did not have a significantly lower PSQI at follow-up (M = 5.19, SD = 2.97) than at baseline (M = 5.90, SD = 2.93), $t(20) = 0.98$, $p < 0.05$).

Table 13

Paired Samples t-tests to Compare Differences in PSQI at Baseline and Follow-up

	Baseline		Follow-up			
	M	SD	M	SD	ΔM	*t*
Intervention (N=21)	7.14	2.53	5.81	2.18	1.33	2.43 *
Placebo (N=21)	5.90	2.93	5.19	2.97	0.62	0.98

* $p<0.05$, ** $p<0.01$

To explore an association between intervention and quality of sleep, additional regression analyses were conducted. Table 14 shows the estimates of the associations between two predictors (i.e., baseline PSQI and intervention) and follow-up PSQI (Model 1) as well as an interaction term of baseline PSQI and intervention (Model 2). Both Model 1 and 2 were statistically significant. To be specific, the Model 1 explanation (*Adjusted* $R^2 = 0.19$, $F(2, 39) = 5.68$, $p < 0.01$) of the variance was 2% higher than the Model 2 explanation (*Adjusted* $R^2 = 0.17$, $F(2, 39) = 3.37$, $p < 0.05$). Similar to GDS, only baseline PSQI statistically predicted follow-up PSQI. Even though the *t*-test results showed a statistically significant difference between baseline PSQI and follow-up PSQI in the intervention group (see Table 13), the regression analyses showed no statistically significant effect of intervention on quality of sleep (see Figure 20).

Table 14

Hierarchical Regression Analyses Showing the Moderation Effect of Intervention Group on the Relationship Between Baseline PSQI and Follow-up PSQI

	Model 1				Model 2			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_PSQI	0.45**	0.14	3.26	1.05	0.44**	0.14	3.13	1.08
Intervention	-0.07	0.75	-0.09	1.05	-0.10	0.76	-0.13	1.06
B_PSQI*Intervention					0.12	0.28	0.43	1.03
Constant	2.69	1.63	1.65		2.83	1.68	1.69	
F	5.68**				3.77*			
Adjusted R^2	0.19				0.17			
Δ *Adjusted* R^2	-				-0.02			

Note. B_PSQI: baseline PSQI
* $p<0.05$, ** $p<0.01$

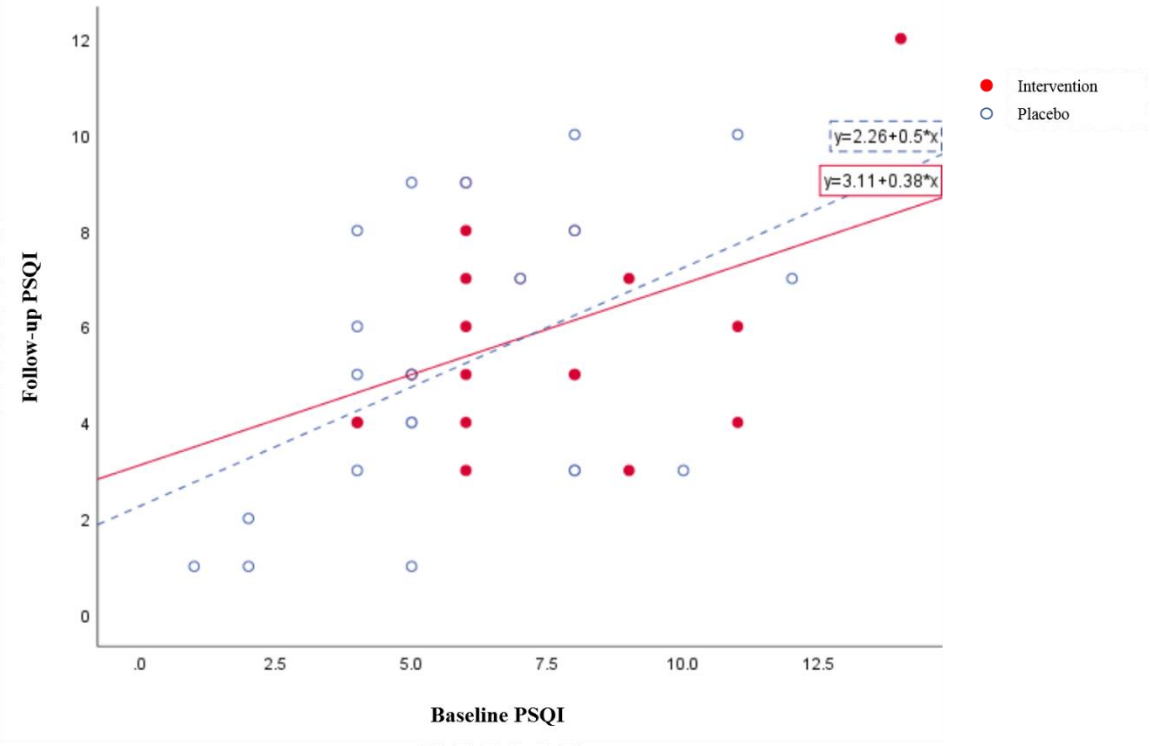


Figure 20. Two groups' regression lines showing the relationship between baseline PSQI and follow-up PSQI

RQ 2.1. As effect modifiers, do distance to a ventilation system, SF, and building in which participants reside affect changes in residents' perceived quality of sleep in long-term care facilities?

To explore the effect modifiers' impact on the changes in PSQI, additional regression analyses were conducted. Table 15 shows the estimates of the associations among major predictors (i.e., baseline PSQI, intervention), each effect modifier (i.e., distance to a ventilation, SF, and building), changes in PSQI (Model 1, 4, and 7) as well as the interaction terms of intervention and baseline PSQI (Model 2, 5, and 8) and each effect modifier (Model 3, 6, and 9).

Regarding the effect of a distance to a ventilation system from a bed, all the three models (Models 1, 2, and 3) were statistically significant. Model 1 (*Adjusted* R^2 = 0.25, $F(3, 38) = 5.61$, $p < 0.01$) has a slightly higher ability to explain the variance than Model 2 (*Adjusted* R^2 = 0.24, $F(4, 37) = 4.15$, $p < 0.05$) and Model 3 (*Adjusted* R^2 = 0.21, $F(4, 37) = 3.23$, $p < 0.01$). However, as the impact of baseline PSQI was only statistically significant on changes in PSQI in three models, the results indicated no measurable effect of the interaction between baseline PSQI and ventilation on changes in depression.

Similarly, three hierarchical regression analyses were further conducted to examine the effect of SF on changes in quality of sleep. Although the three models (Models 4, 5, and 6) were all statistically significant, Model 4 (*Adjusted* R^2 = 0.30, $F(3, 38) = 6.79$, $p < 0.01$) had a slightly higher ability to explain the variance than Model 5 (*Adjusted* R^2 = 0.28, $F(4, 37) = 4.96$, $p < 0.01$) and Model 6 (*Adjusted* R^2 = 0.26, $F(5, 36) = 3.88$, $p < 0.01$). Again, only baseline PSQI statistically predicted changes in PSQI in

the three models, and the results indicated no measurable effect of the interaction between baseline PSQI and SF on changes in depression.

Finally, the moderation impacts of the intervention groups on the association between the different buildings and changes in PSQI were examined. Models 7, 8, and 9 were statistically significant; however, Model 7 (*Adjusted* R^2 = 0.27, F(4, 37) = 4.72, $p <$ 0.01) explained the variance slightly more than Model 8 (*Adjusted* R^2 = 0.25, F(5, 36) = 3.68, $p < 0.05$) and Model 9 (*Adjusted* R^2 = 0.24, F(7, 34) = 2.81, $p < 0.05$). Only baseline PSQI was statistically able to predict the changes in PSQI. In conclusion, no statistically significant impact of effect modifiers on changes in PSQI was found. Additional regression analyses were conducted by adding the control variables (i.e., gender and age) to each model. The results were consistent, indicating baseline PSQI as the only statistically significant predictor of changes in PSQI.

Table 15

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline PSQI and Follow-up PSQI

Ventilation effect	Model 1				Model 2				Model 3			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_PSQI	0.55**	0.14	3.94	1.07	0.56**	0.14	3.91	1.10	0.56**	0.15	3.81	1.12
Intervention	0.04	0.77	0.05	1.07	0.07	0.78	0.10	1.09	0.07	0.80	0.08	1.11
Ventilation	0.08	0.29	0.28	1.03	0.06	0.30	0.22	1.05	0.06	0.30	0.22	1.05
B_ PSQI *Intervention					-0.11	0.29	-0.39	1.04	-0.11	0.29	-0.37	1.07
Ventilation*Intervention									-0.04	0.60	-0.06	1.05
Constant	-3.22	2.53	-1.27		-3.25	2.56	-1.27		-3.23	2.62	-1.23	
F	5.61**				4.15**				3.23**			
Adjusted R^2	0.25				0.24				0.21			
Δ *Adjusted* R^2					-0.01				-0.04			
SF effect	Model 4				Model 5				Model 6			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_ PSQI	0.51**	0.14	3.70	1.10	0.51**	0.14	3.59	1.15	0.50**	0.15	3.44	1.19
Intervention	-0.19	0.75	-0.25	1.10	-0.18	0.77	-0.23	1.13	-0.21	0.79	-0.26	1.16
SF	0.03	0.02	1.60	1.08	0.27	0.02	1.51	1.15	0.03	0.02	1.40	1.22
B_ PSQI *Intervention					-0.11	0.28	-0.04	1.10	0.00	0.29	0.00	1.14
SF*Intervention									-0.01	0.04	-0.22	1.21
Constant	-7.61*	3.47	-2.19		-7.59*	3.55	-2.14		-7.28	3.86	-1.89	
F	6.79**				4.96**				3.88**			
Adjusted R^2	0.30				0.28				0.26			
Δ *Adjusted* R^2	-				-0.02				-0.04			

Note. B_ PSQI: baseline PSQI

* $p<0.05$, ** $p<0.01$

Table 15 (Continue)

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline PSQI and Follow-up PSQI

Building effect	Model 7				Model 8				Model 9			
	β	*SE B*	*t*	VIF	β	*SE B*	*T*	VIF	β	*SE B*	*t*	VIF
B_ PSQI	0.54**	0.14	3.87	1.08	0.54**	0.14	3.76	1.13	0.46**	0.16	2.93	1.34
Intervention	0.14	0.76	0.19	1.06	0.15	0.77	0.20	1.07	-0.04	0.79	-0.05	1.12
Building 1	-0.05	0.94	-0.05	1.40	-0.01	1.01	-0.01	1.57	-0.07	1.02	-0.07	1.58
Building 2	-1.05	0.90	-1.16	1.42	-1.00	0.98	-1.03	1.63	-1.15	0.99	-1.16	1.66
B_ PSQI *Intervention					-0.04	0.30	-0.13	1.21	0.05	0.32	0.17	1.28
Building 1*Intervention									2.18	2.03	1.07	1.57
Building 2*Intervention									2.22	1.98	1.12	1.66
Constant	-2.27	1.76	-1.29		-2.36	1.90	-1.24		-1.48	2.04	-0.73	
F	4.72**				3.68**				2.81*			
Adjusted R^2	0.27				0.25				0.24			
Δ *Adjusted* R^2	-				-0.02				-0.03			

Note. B_ PSQI: baseline PSQI
* $p<0.05$, ** $p<0.01$

Participants Not Having A Roommate

The demographic information describing the intervention and placebo groups in the second dataset is summarized in Table 16. The demographics (e.g., gender and age) and the built environment (e.g., building, distance to a ventilation system, and square footage) were not statistically different in comparing the two groups. These results showed that the 48 residents were evenly distributed to either the intervention or placebo group through the stratified randomization.

Table 16

Demographic Information about Two Groups (n=48)

		Intervention (N=24)		Placebo (N=24)			
		N	%	N	%	x^2	
Gender	Female	16	66.7	18	75.0	0.40	
	Male	8	33.3	6	25.0		
Building	Building A (Long-Term Care A)	9	37.5	9	37.5	0.00	
	Building B (Long-Term Care A)	10	41.7	10	41.7		
	Building C (Long-Term Care B)	5	20.8	5	20.8		
		M	SD	M	SD	ΔM	*t*
Age (year)		82.00	11.10	85.00	9.13	3.00	1.02
Ventilation (ft)		7.46	1.15	7.63	1.13	0.17	0.51
SF (ft^2)		201.96	23.15	208.25	16.59	6.29	1.08

* $p<0.05$, ** $p<0.01$

Like the first dataset, normality of the main variables in the second dataset was also tested via Shapiro-Wilk because of the small sample size (Park, 2015). Given that $p = 0.26$ for baseline GDS, $p = 0.27$ for follow-up GDS, $p = 0.05$ for changes in GDS, $p = 0.17$ for baseline PSQI, $p = 0.22$ for follow-up PSQI, and $p = 0.06$ for changes in PSQI, all the main variables were normally distributed at the significant level of 0.05. Linearity,

independency, and homogeneity of variance were also examined prior to regression analyses with the same methods used for the first dataset.

Table 17 describes correlations among the variables in this study. Baseline GDS had moderate and positive correlations with follow-up GDS ($r = 0.40$, $p < 0.01$) and change in GDS ($r = 0.50$, $p < 0.01$). Follow-up GDS had a strong and negative correlation with change in GDS ($r = -0.60$, $p < 0.01$). Similar to GDS, baseline PSQI also had moderate and positive correlations with follow-up PSQI ($r = 0.45$, $p < 0.01$) and change in GDS ($r = 0.49$, $p < 0.01$). Again, follow-up PSQI also had a moderate and negative correlation with change in PSQI ($r = -0.56$, $p < 0.01$). Distance to a ventilation system from a resident's bed had a moderate and positive correlation with square footage ($r = 0.59$, $p < 0.01$).

Table 17

Pearson Correlation Among Variables (n=48)

	Baseline GDS	Follow-up GDS	Change in GDS	Baseline PSQI	Follow-up PQSI	Change in PSQI	Ventilation	SF	Gender	Age
Baseline GDS	-									
Follow-up GDS	0.40**	-								
Change in GDS	0.50**	-0.60**	-							
Baseline PSQI	-0.18	-0.01	-0.26	-						
Follow-up PSQI	-0.13	-0.13	-0.01	0.45**	-					
Change in PSQI	-0.14	0.13	-0.25	0.49**	-0.56**	-				
Ventilation	-0.16	-0.06	-0.13	-0.14	0.01	0.06	-			
SF	-0.16	-0.03	-0.14	0.01	-0.14	0.25	0.59**	-		
Gender	-0.12	0.04	0.02	-0.28	-0.19	-0.06	0.16	0.02	-	
Age	0.05	0.10	-0.33	0.22	-0.34*	0.38*	0.02	0.21	-0.38**	-

* $p<0.05$, ** $p<0.01$

Unlike the first dataset, age had a moderate and negative correlation with follow-up PSQI (r = -0.34, $p < 0.05$) and a moderate and positive correlation with change in PSQI (r = 0.37, $p < 0.05$). The results implied that older participants would be more likely to receive a lower score in PSQI at follow-up and a greater improvement in quality of sleep at follow-up from baseline.

Depression

RQ 1. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' depression in long-term care facilities?

To answer RQ 1, a series of *t*-tests were conducted. First of all, Table 18 describes the independent *t*-tests that were conducted to compare group differences in GDS scores at both baseline and follow-up stages. The results indicated that there was no difference in GDS at baseline [$t(46) = 0.00$, p = n.s.] and follow-up [$t(33) = 0.91$, p = n.s.] between the intervention and placebo group.

Table 18

Independent t-tests to Compare Group Differences in GDS at Baseline and Follow-up Stages

	Intervention		Placebo			
	M	SD	M	SD	ΔM	*t*
Baseline (N=48)	4.88	2.10	4.88	1.94	0.00	0.00
Follow-up (N=35)	3.47	2.07	3.56	2.15	0.09	0.91

* $p<0.05$, ** $p<0.01$

Table 19 describes the paired samples *t*-tests that were conducted to compare GDS scores at baseline and follow-up for each group. The results showed that both the intervention and placebo groups had a statistically significant difference in GDS at

follow-up from baseline. To be specific, the intervention group had significantly lower GDS at follow-up (M = 3.47, SD = 2.07) than at baseline (M = 4.59, SD = 1.73), $t(16) = 2.12$, $p < 0.05$). The placebo group also had a significantly lower GDS at follow-up (M = 3.56, SD = 2.15) than at baseline (M = 4.94, SD = 2.13), $t(17) = 2.59$, $p < 0.05$). Interestingly, as the results showed, the placebo group (ΔM = 1.39) had a slightly bigger difference in GDS between baseline and follow-up than the intervention group (ΔM = 1.12).

Table 19

Paired Samples t-tests to Compare Differences in GDS at Baseline and Follow-up

	Baseline		Follow-up			
	M	SD	M	SD	ΔM	*t*
Intervention (N=17)	4.59	1.73	3.47	2.07	1.12	2.12*
Placebo (N=18)	4.94	2.13	3.56	2.15	1.39	2.59*

* $p<0.05$, ** $p<0.01$

To explore a moderation effect of intervention group on the association of depression scores, additional regression analyses were conducted. Table 20 shows the estimates of the associations between two predictors (i.e., baseline GDS and intervention) and follow-up GDS (Model 1) as well as an interaction term of baseline GDS and intervention (Model 2). Neither Model 1 (*Adjusted* $R^2 = 0.11$, $F(2, 32) = 3.01$, p = n.s.) nor Model 2 was statistically significant (*Adjusted* $R^2 = 0.08$, $F(2, 32) = 1.95$, p = n.s.). This result indicated that the intervention had no measurable effect on depression (see Figure 21).

Table 20

Hi*erarchical Regression Analyses Showing the Moderation Effect of Intervention Group on the Relationship Between Baseline GDS and Follow-up GDS*

	Model 1				Model 2			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.43*	0.18	2.45	1.01	0.43*	0.18	2.34	1.07
Intervention	-0.07	0.67	-0.10	1.01	-0.07	0.68	-0.10	1.01
B_GDS*Intervention					0.01	0.37	0.04	1.06
Constant	1.56	1.29	1.28		1.57	1.32	1.19	
F	3.01				1.95			
Adjusted R^2	0.11				0.08			
Δ *Adjusted* R^2	-				-0.03			

Note. B_GDS: baseline GDS
* $p<0.05$, ** $p<0.01$

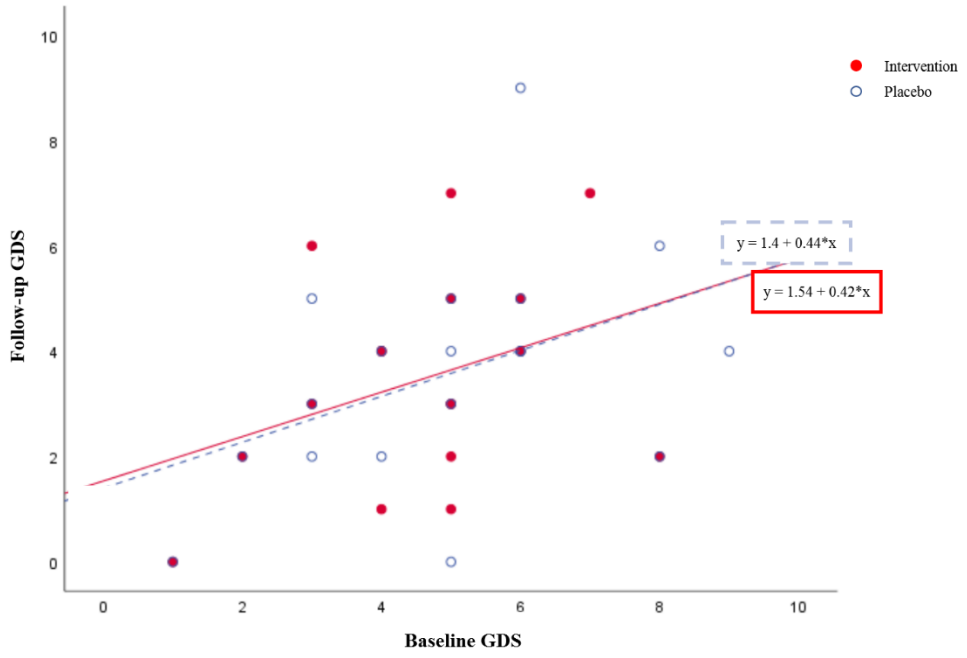


Figure 19. Two groups' regression lines showing the relationship between baseline GDS and follow-up GDS

RQ 1.1. As effect modifiers, do distance to a ventilation system, SF, and building in which the participants reside affect changes in residents' depression in long-term care facilities?

To explore the moderation impact of intervention groups on the association between other variables (i.e., distance to a ventilation system, SF, and building) and changes in GDS, additional regression analyses were conducted. Table 21 shows the estimates of the associations among major predictors (i.e., baseline GDS, intervention), each effect modifier (i.e., distance to a ventilation, SF, and building) and changes in GDS (Model 1, 4, and 7) as well as the interaction terms of intervention and baseline GDS (Model 2, 5, and 8) and each effect modifier (Model 3, 6, and 9).

Regarding the effect of distance to a ventilation system from a bed, only Model 1 (*Adjusted* R^2 = 0.18, F(3, 31) = 3.46, $p < 0.05$) was statistically significant. Again, only baseline GDS ($\beta = 0.56$, $p < 0.01$) statistically predicted changes in GDS in Model 1, and the results indicated no measurable effect of the interaction between baseline GDS and ventilation on changes in depression.

Similarly, three hierarchical regression analyses were conducted to examine the effect of SF on changes in depression. Only Model 4 was statistically significant (*Adjusted* R^2 = 0.18, F(3, 31) = 3.49, $p < 0.05$), and baseline GDS ($\beta = 0.57$, $p < 0.01$) was the only statistically significant predictor regarding changes in GDS in Model 4. The results indicated no measurable effect of the interaction between baseline GDS and SF on changes in depression.

Table 21

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline GDS and Follow-up GDS

Ventilation effect	Model 1				Model 2				Model 3			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.56**	0.18	3.08	1.06	0.56**	0.19	2.93	1.13	0.55**	0.20	2.79	1.15
Intervention	0.09	0.69	0.13	1.03	0.09	0.70	0.12	1.04	0.26	0.75	0.34	1.16
Ventilation	-0.05	0.32	-0.17	1.07	-0.05	0.32	-0.17	1.09	-0.07	0.33	-0.21	1.09
B_GDS*Intervention					-0.01	0.38	0.02	1.07	0.06	0.39	0.16	1.14
Ventilation*Intervention									0.46	0.66	0.71	1.17
Constant	-1.16	2.71	-0.43		-1.17	2.78	-0.42		-1.26	2.81	-0.35	
F	3.46*				2.51				2.08			
Adjusted R^2	0.18				0.15				0.14			
Δ *Adjusted* R^2	-				-0.03				-0.04			
SF effect	Model 4				Model 5				Model 6			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.57*	0.18	3.04	1.06	0.57**	0.19	2.89	1.14	0.56**	0.20	2.84	1.14
Intervention	0.13	0.70	0.18	1.08	0.13	0.71	0.18	1.08	0.13	0.76	0.17	1.18
SF	-0.01	0.02	-0.33	1.11	-0.01	0.02	-0.32	1.13	-0.01	0.02	-0.30	1.21
B_GDS*Intervention					0.00	0.38	0.00	1.08	0.00	0.39	0.00	1.13
SF*Intervention									0.00	0.04	0.00	1.28
Constant	-0.52	3.47	-0.15		-0.51	3.57	-0.14		-0.52	3.84	-0.14	
F	3.49*				2.54				1.96			
Adjusted R^2	0.18				0.15				0.12			
Δ *Adjusted* R^2	-				-0.03				-0.06			

Note. B_GDS: baseline GDS

* $p<0.05$, ** $p<0.01$

Table 21 (Continue)

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline GDS and Follow-up GDS

Building effect	Model 7				Model 8				Model 9			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_GDS	0.55**	0.18	3.04	1.06	0.56**	0.19	2.95	1.09	0.55**	0.20	2.82	1.13
Intervention	0.06	0.67	0.09	1.01	0.06	0.69	0.08	1.02	-0.02	0.78	-0.02	1.25
Building 1	-1.22	0.98	-1.24	2.02	-1.23	1.00	-1.23	2.04	-1.27	1.04	-1.22	2.05
Building 2	-0.93	0.95	-0.98	2.00	-0.94	0.97	-0.97	2.01	-0.96	1.00	-0.97	2.01
B_GDS*Intervention					-0.06	0.37	-0.16	1.08	-0.10	0.39	-0.26	1.12
Building 1*Intervention									-0.13	2.08	-0.06	2.07
Building 2*Intervention									0.70	2.00	0.35	2.11
Constant	-0.59	1.52	-0.39		-0.60	1.55	-0.39		-0.45	1.65	-0.27	
F	3.02*				2.35				1.62			
Adjusted R^2	0.19				0.17				0.11			
Δ *Adjusted* R^2	-				-0.05				-0.08			

Note. B_GDS: baseline GDS
* $p<0.05$, ** $p<0.01$

Lastly, the moderation impacts of the intervention groups on the association between the different buildings and changes in GDS were examined. Model 7 (*Adjusted* $R^2 = 0.25$, $F(4, 37) = 4.39$, $p < 0.01$) was statistically significant, and only baseline GDS ($\beta = 0.55$, $p < 0.01$) was statistically able to predict the changes in GDS. In conclusion, no statistically significant impact of effect modifiers on changes in GDS was found. Additional regression analyses were conducted by adding the control variables (i.e., gender and age) to each model. The results were consistent, indicating baseline GDS as the only statistically significant predictor of changes in GDS.

Quality of Sleep

RQ 2. Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' perceived quality of sleep in long-term care facilities?

To answer RQ 2, a series of *t*-tests were conducted. First of all, Table 22 describes the independent *t*-tests that were conducted to compare group differences in PSQI scores at both baseline and follow-up stages. The results indicated that there was no difference in PSQI at baseline [$t(46) = 0.72$, p = n.s.] and follow-up [$t(33) = 0.87$, p = n.s.] between the intervention and placebo group.

Table 22

Independent t-tests to Compare Group Differences in PSQI at Baseline and Follow-up Stages

	Intervention		Placebo			
	M	SD	M	SD	ΔM	*t*
Baseline (N=48)	6.21	2.21	5.96	2.56	0.25	0.72
Follow-up (N=35)	5.65	1.80	5.50	3.13	0.15	0.87

* $p<0.05$, ** $p<0.01$

Table 23 describes the paired samples *t*-tests that were conducted to compare PSQI scores at baseline and follow-up for each group. The results showed that neither the intervention [$t(16) = 1.67$, p = n.s.] nor placebo group [$t(17) = 0.74$, p = s.g.] had a statistically significant difference in PSQI at follow-up from baseline.

Table 23

Paired Samples t-tests to Compare Differences in PSQI at Baseline and Follow-up

	Baseline		Follow-up			
	M	SD	M	SD	ΔM	*t*
Intervention (N=17)	6.59	1.87	5.65	1.80	0.94	1.67
Placebo (N=18)	6.00	2.83	5.50	3.13	0.50	0.74

* $p<0.05$, ** $p<0.01$

To explore a moderation effect of intervention group on the association of PSQI scores, additional regression analyses were conducted. Table 24 shows the estimates of the associations between two predictors (i.e., baseline PSQI and intervention) and follow-up PSQI (Model 1) as well as an interaction term of baseline PSQI and intervention (Model 2). Both Model 1 (*Adjusted* $R^2 = 0.15$, $F(2, 32) = 4.01$, $p < 0.05$) and Model 2 were statistically significant (*Adjusted* $R^2 = 0.16$, $F(2, 32) = 3.10$, $p < 0.05$). However, in both models, only baseline PSQI was a statistically significant predictor of follow-up PSQI. This result indicated that the intervention had no measurable effect on quality of sleep. Even though Figure 22 shows the different slopes about the relationship between baseline and follow-up PSQI scores for the intervention and placebo groups, the intervention had no statistically significant impact on quality of sleep.

Table 24

Hi*erarchical Regression Analyses Showing the Moderation Effect of Intervention Group on the Relationship Between Baseline PSQI and Follow-up PQSI*

	Model 1				Model 2			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_PSQI	0.48**	0.17	2.83	1.02	0.39*	0.37	2.12	1.23
Intervention	0.13	0.80	0.17	1.02	0.10	0.79	0.13	1.02
B_PSQI*Intervention					0.41	0.19	1.10	1.21
Constant	2.38	1.75	1.36		3.02	1.84	1.64	
F	4.01*				3.10*			
Adjusted R^2	0.15				0.16			
Δ *Adjusted* R^2	-				0.01			

Note. B_PSQI: baseline PSQI
* $p<0.05$, ** $p<0.01$

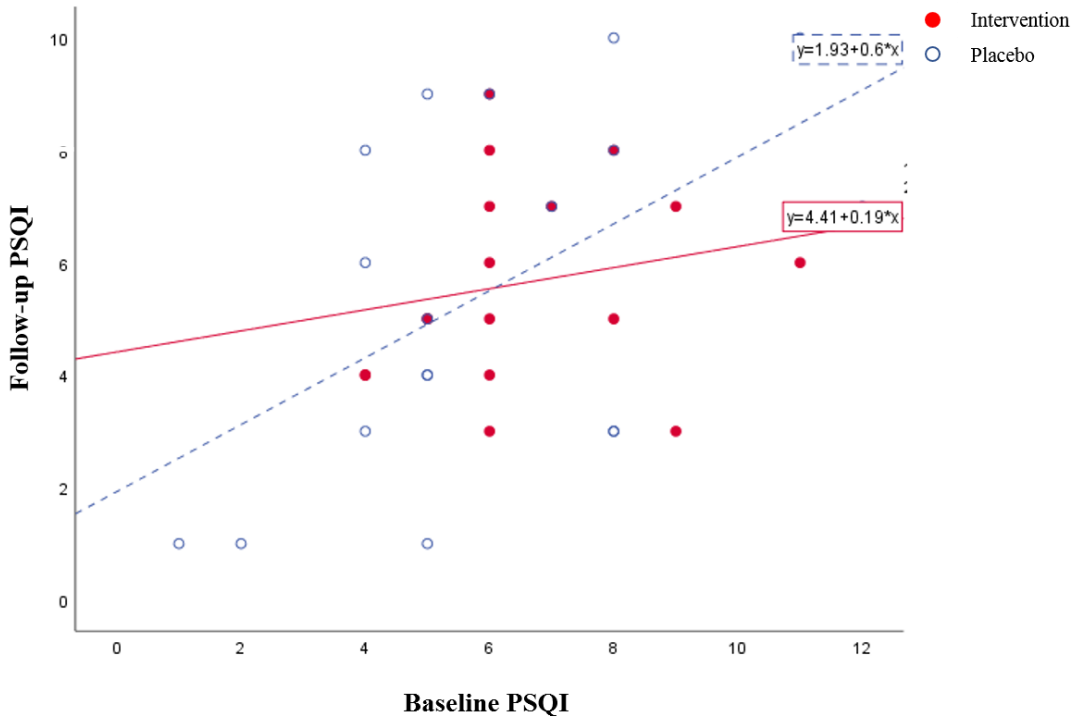


Figure 20. Two groups' regression lines showing the relationship between baseline PSQI and follow-up PSQI

RQ 2.1. As effect modifiers, do distance to a ventilation system, SF, and building in which the participants reside affect changes in residents' perceived quality of sleep in long-term care facilities?

To explore the moderation impact of intervention groups on the association between other variables (i.e., distance to a ventilation system, SF, and building) and changes in PSQI, additional regression analyses were conducted. Table 21 shows the estimates of the associations among major predictors (i.e., baseline PSQI, intervention), each effect modifier (i.e., distance to a ventilation, SF, and building) and changes in PSQI (Model 1, 4, and 7) as well as the interaction terms of intervention and baseline PSQI (Model 2, 5, and 8) and each effect modifier (Model 3, 6, and 9).

Regarding the effect of distance to a ventilation system from a bed, all the three models (Models 1, 2, and 3) were statistically significant. Model 3 (*Adjusted* R^2 = 0.24, $F(5, 29) = 3.09$, $p < 0.05$) has the highest ability to explain the variance than Model 1 (*Adjusted* R^2 = 0.17, $F(3, 31) = 3.24$, $p < 0.05$) and Model 2 (*Adjusted* R^2 = 0.17, $F(4, 30) = 2.72$, $p < 0.05$). However, as the impact of baseline PSQI was only statistically significant on changes in PSQI in the three models, the results indicated no measurable effect of the interaction between baseline PSQI and ventilation on changes in quality of sleep.

Similarly, three hierarchical regression analyses were further conducted to examine the effect of SF on changes in quality of sleep. Although the three models (Models 4, 5, and 6) were all statistically significant, Model 4 (*Adjusted* R^2 = 0.21, $F(3, 31) = 3.99$, $p < 0.05$) had a slightly higher ability to explain the variance than Model 5

(*Adjusted* R^2 = 0.20, F(4, 30) = 3.15, $p < 0.05$) and Model 6 (*Adjusted* R^2 = 0.18, F(5, 29) = 2.49, $p < 0.05$). Again, only baseline PSQI statistically predicted changes in PSQI in the three models, and the results indicated no measurable effect of the interaction between baseline PSQI and SF on changes in quality of sleep.

Table 25

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline PSQI and Follow-up PSQI

Ventilation effect	Model 1				Model 2				Model 3			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_PSQI	0.52**	0.17	3.03	1.02	0.61**	0.19	3.20	1.25	0.56**	0.18	3.03	1.28
Intervention	-0.16	0.82	-0.20	1.04	-0.12	0.82	-0.14	1.04	-0.61	0.83	-0.73	1.16
Ventilation	0.10	0.37	0.26	1.02	0.04	0.37	0.11	1.04	0.07	0.36	0.20	1.05
B_ PSQI *Intervention					-0.40	0.38	-1.06	1.23	-0.31	0.37	-0.85	1.26
Ventilation*Intervention									-1.35	0.71	-1.89	1.13
Constant	-3.02	3.04	-1.00		-3.28	3.04	-1.08		-2.33	2.96	-0.79	
F	3.24*				2.72*				3.09*			
Adjusted R^2	0.17				0.17				0.24			
Δ *Adjusted* R^2					0.00				0.07			
SF effect	Model 4				Model 5				Model 6			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_ PSQI	0.49**	0.17	2.90	1.04	0.56**	0.19	2.96	1.30	0.55**	0.19	2.82	1.33
Intervention	-0.40	0.81	-0.49	1.08	-0.34	0.82	-0.41	1.09	-0.45	0.87	-0.52	1.19
SF	0.03	0.02	1.33	1.08	0.02	0.02	1.12	1.13	0.02	0.02	0.97	1.20
B_ PSQI *Intervention					-0.32	0.38	-0.85	1.26	-0.29	0.39	-0.75	1.31
SF*Intervention									-0.02	0.04	-0.44	1.26
Constant	-6.73	3.70	-1.82		-6.64	3.72	-1.79		-5.92	4.11	-1.44	
F	3.99*				3.15*				2.49*			
Adjusted R^2	0.21				0.20				0.18			
Δ *Adjusted* R^2	-				-0.01				-0.03			

Note. B_ PSQI: baseline PSQI

* $p<0.05$, ** $p<0.01$

Table 25 (Continue)

Hierarchical Regression Analyses Showing the Effect Modifiers (Ventilation, SF, and Building) on the Relationship Between Baseline PSQI and Follow-up PSQI

Building effect	Model 7				Model 8				Model 9			
	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF	β	*SE B*	*t*	VIF
B_ PSQI	0.52**	0.17	3.02	1.02	0.61**	0.19	3.20	1.28	0.46*	0.20	2.34	1.48
Intervention	-0.06	0.81	-0.07	1.02	-0.03	0.81	-0.04	1.02	-0.92	0.88	-1.05	1.33
Building 1	0.53	1.17	0.46	1.99	0.94	1.22	0.77	2.19	0.79	1.18	0.67	2.21
Building 2	-0.45	1.14	-0.40	2.00	0.01	1.20	0.01	2.27	-0.26	1.17	-0.23	2.31
B_ PSQI *Intervention					-0.44	0.40	-1.10	1.38	-0.27	0.39	-0.67	1.45
Building 1*Intervention									4.66	2.35	1.98	2.23
Building 2*Intervention									4.61	2.33	1.98	2.41
Constant	-2.44	1.99	-1.22		-3.50	2.21	-1.59		-1.02	2.42	-0.42	
F	2.73*				2.45				2.55*			
Adjusted R^2	0.17				0.18				0.24			
Δ *Adjusted* R^2	-				0.01				0.07			

Note. B_ PSQI: baseline PSQI
* $p<0.05$, ** $p<0.01$

Finally, the moderation impacts of the intervention groups on the association between the different buildings and changes in PSQI were examined. Model 7 and 9 were statistically significant. To be specific, Model 9 (*Adjusted* R^2 = 0.24, F(7, 27) = 2.55, $p <$ 0.05) explained the variance more than Model 7 (*Adjusted* R^2 = 0.17, F(4, 30) = 2.73, $p <$ 0.05). However, only baseline PSQI was statistically able to predict the changes in PSQI. In conclusion, no statistically significant impact of effect modifiers on changes in PSQI was found.

Open-ended Questions

At the end of the two-week intervention, a post-experimental oral interview consisting of four open-ended questions was conducted after the follow-up questionnaires. The first two questions were about the intervention they experienced, and the subsequent two questions were about the interior environments they were living. Out of 58 participants, 42 participants who completed the intervention were asked the four questions. In addition, ten participants who dropped in the middle of the study or did not follow the instructions were asked only the last two questions regarding the interior environment, and six participants were totally lost for the post-experimental oral interview.

Post-experimental Interview – Intervention

The participants were asked how they liked the scent of intervention and what experience they had with the intervention jar in their room for two weeks. In the intervention group, 16 (76.2%) out of 21 participants said they liked the scent. Four

participants (19.0%) said they did not notice any scent from the jar because it was not strong at all, so they wished it would be stronger. Lastly, only one participant (5.8%) said that the scent was little strong. In the placebo group, seven (33.3%) out of 21 participants said they liked the scent (19.0%), the scent was not bad (9.5%), and acceptable (4.8%). Rest of the participants (66.7%) mentioned that they could not detect any scent or could not smell it because it was not strong at all. Three participants in particular mentioned that they could not smell anything, but they knew the jar was there.

The participants were further asked about their experience with having the jar in their room. In the intervention group, three out of 21 participants (14.3%) simply answered that having the jar in the room was okay and no adverse experience was found. Ten participants (47.6%) mentioned they had good experience. Without prompting, seven of them said the scent helped them sleep and four of them mentioned they experienced positive impact on their mood. To be specific, one participant said, *"The scent helped me ~~in~~ sleep and stay asleep. First night that I had the jar in my room, I had a very good dream and my sleep was great!"* Another person noted about her mood by saying that *"I really enjoyed having it. I feel better, but I am not sure what makes me feel better"*. In addition, one person also commented about her improved mood:

> *It (the jar with lavender scent) helped my mood for sure. If you take it away from me today, I would not feel any difference of it, but I really like having it with me… I think it is good for mental health, than physical health.*

There was also one person who experienced positive impact of having the lavender jar in the room. The participant mentioned that the scent helped his ability to

concentrate, like puzzle and reading a book. Rest of the participants in the intervention group replied that they could not detect any positive or negative experience of the lavender scent in their room.

Most participants in the placebo group (81%) mentioned that they did not notice any positive nor negative experience of the lavender jar in their room. The majority of their comments indicated that the jar did not bother the participants at all because they could not even smell it. One participant who said that she liked the scent answered that she experienced good smell from the jar. Two participants explained they experienced improvement to their mood. For example, one participant mentioned that *"Even though I don't feel any difference (in my conditions), I would love to have it in my room. It soothes my feelings and mood."* Interestingly, another participant commented that *"I enjoyed it very much. I actually just looked at the jar and talk to it. Talking with it makes me feel better!"*

In the intervention group, more than half of the participants indicated that they had positive experience with having the jar in their room, and most of their positive experience was related to improved quality of sleep. The second most common positive experience was better mood among the participants in the intervention group. In the placebo group, most of them did not have any positive nor negative experience. Some of the participants in the placebo group also mentioned better mood as a positive impact of the jar in their room.

After asking the two questions about the intervention experience, the participants were told whether they were allocated the intervention or the placebo group. Even though

the participants in the placebo group thought the scent was too weak, they did not notice their allocation to the placebo group.

RQ 3.1 – The Interior Environment They Like

The participants were asked to list up to three interior environments they like in their living environments. Their answers were coded into appropriate interior environment themes representing the main idea in their responses. In addition, the responses indicating similar ideas were categorized into the same themes. Table 26 describes the most frequently mentioned interior environment themes that participants liked in descending order.

Majority of the interior environment they mentioned were associated with their rooms. To be specific, the most frequently listed interior environment was "window & view" (9%), followed by "pictures & photos" (9%) and TV (9%). One participant specifically mentioned that he loves to see the sunset every day and the views through the window. The participants also liked ample daylighting they can get through the window. Another participant also mentioned that *"I can see the morning sun through the window every morning. That's how I start my day!"* In addition, one participant noted her pleasure to see outside from her room:

> *I love going outside. However, I cannot always go outside due to my health conditions. Looking outside while sitting on a chair feels good. When the weather is bad, especially in winter, I am so glad that I have a window in my room.*

Seeing outside just makes me relax. Of course, going outside is much better, but it is not my case.

Table 26

The Rankings of the Frequently Mentioned Interior Environment Themes that Participants Liked

Rank	Interior Environment	Count (%)	Rank	Interior Environment	Count (%)
1	Window & View	11 (9%)	13	Amenities	3 (3%)
2	Pictures & Photos	10 (9%)	18	Cleanliness	2 (2%)
2	TV	10 (9%)	18	Closeness & Adjacency	2 (2%)
4	Private room/Privacy	9 (8%)	18	Spacious room	2 (2%)
5	Bed	7 (6%)	18	Places for visitors	2 (2%)
5	Flowers	7 (6%)	23	Arts	1 (1%)
5	Access to staff	7 (6%)	23	Books in living rooms	1 (1%)
8	Garden & Outdoor	6 (5%)	23	Clock	1 (1%)
9	Bathroom	4 (3%)	23	Colors	1 (1%)
9	Lighting	4 (3%)	23	Comfort	1 (1%)
9	Personal items	4 (3%)	23	Dining room	1 (1%)
9	Activity programs	4 (3%)	23	Hard floor	1 (1%)
13	Chair(s)	3 (3%)	23	Room layout	1 (1%)
13	Closet	3 (3%)	23	Living room	1 (1%)
13	Quietness/ Acoustic	3 (3%)	23	Safety	1 (1%)
13	Temperature control	3 (3%)	23	Wall decoration	1 (1%)

The second most frequently mentioned interior environment that the participants liked were “pictures and photos” and “TV” in their room. To be specific, in the participants’ room, lots of pictures were photos hung on the walls or doors and placed on tables or shelves. The majority of the pictures and photos were related to their family members. Some of the photos were about what they like and/or care, such as flowers, animals, scenery, etc. One participant noted that *“I really like how I can place the pictures of my family nearby my bedside. I can always see them so easily.”*

The participants also liked the TV in their room. Most of them mentioned they spend the majority of their time watching a TV while they are in the room. The participants liked their ability to control their TV in their room. One participant noted that *"I like having a TV in my room. I can control my TV here, so I usually watch it in my room, not in the living room. Every night, I watch a TV and fall asleep. It's my routine."* Additional participant described her TV as her best friend.

The next most frequently mentioned favorable interior environment was private room and privacy. The participants were glad to have the ability to make their room private to keep their own privacy. In addition to a private bedroom, some participants commented their private bathroom. They appreciated anything they can feel privacy in the facility. One participant mentioned that *"Even though anyone can enter my room by opening the door and disturb me, this is my space! I am the only owner of this room and make it private. This room is like my whole house for me."*

The fifth most frequently mentioned interior environment that the participants liked were "beds", "plants and flowers", and "access to staff". Five participants were gratified by that they can literally adjust their bed (e.g., angle and height) by themselves and for themselves. They mentioned their bed is very comfortable due to the adjustability. Two participants mentioned the mattress they brought and put it on their beds. One participant, in particular, noted that *"I brought my form mattress for myself. It is very comfortable and helps me get a good night's rest. I really like it!"*

In addition, majority of the participants had plants and flowers in their room. The participants loved the ability that they can bring their own plants and flowers into their

rooms. They mentioned that they frequently talk to the plants and flowers and care a lot them. They enjoyed caring them, such as giving water to them, as their routine life. The participants who liked flowers in their room also mentioned that their visitors (e.g., family members) frequently brought flowers for them. Therefore, the participants could think of the people who brought the flowers when looking at those flowers. One participant actually had fake flowers on the table, and she shared her story with her fake flower.

> *A while ago, my daughter brought very pretty and live flowers for me. They were so pretty. I always looked at them. However, when they died, I was so sad. Then my daughter brought these fake flowers. They last forever and ever and forever so that's very good. Watching those flowers makes me feel calm and good.*

Regarding the access to staff, the participants liked how they can easily access to their staff. Nearby their bed, they had a button to call their staff if they need any help from the staff members. They mentioned the environment is great for both residents and staff, so they could get great support from their staff.

Another frequently commented interior environment that the participants liked was "garden and outdoor". The participants appreciated those places they can spend their time and hang out with their visitors. The participants who listed garden/outdoor as their favorable environment mentioned that those places are their favorite space in the facility, along with their bed rooms. The Majority of them said that spending their time in garden/outdoor helps them relax. One participant noted that *"I love hanging out in the garden when my family visits me. They always take me outside when they come here to*

see me. We have a meal together outside. Being outside always feels good. I really enjoy fresh air there. I can see flowers, birds, and ducks in the pond!" Furthermore, three out of six participants, in fact, talked about ducks they can see in the garden. One participant, in specific, mentioned that *"I sometimes spend my time just watching ducks in the pond. The pond and gardens are clean and very well-maintained. I wish we have more ducks. I just love watching them. They live! I do love watching those live ducks, and I feel like they give me some energy"* Another participant also said that:

> *The garden is my favorite place. I was about to go outside, but you just came. Once our interview is done, I will go out and spend my time there. I used to have huge gardens in the front and back of my house. I miss my private gardens, but I am so glad that this facility has gardens I can visit. Spending time there makes me peaceful.*

In addition, regarding "bathroom", participants liked their bathroom. Two of them liked that the bathroom is private and located inside of their room. One participant liked the spacious bathroom, and another participant mentioned the proximity to bathroom from her bedside. When the participants commented about lighting, one participant referenced the natural lighting and three participants referenced the electrical lighting. They liked the amount of lighting as well as adjustability of the lighting. Moreover, the participants were satisfied with the ability to bring their personal items into their rooms. They mentioned they wanted to bring their comfortable items that they had used for long time and to make the place for their own space. They also appreciated that they could make their room show their own identity with their personal items.

RQ 3.2 – The Interior Environment They Want to Improve

As the last question, the participants were asked to comment on up to three interior environments they want to make change or to improve in their living environments. Similar to the previous question, their responses were coded into appropriate themes which represent their main idea, and the responses indicating similar ideas were categorized into the same themes. Table 27 describes the most frequently mentioned interior environment themes that participants wanted to improve in descending order. As Table 27 describe, some of their comments were more related to the support they get from the facility rather than simply related to the interior environment. Since the participants' responses to the question about improvement covered their expectations to the facility, the scope of the analyses was expanded to the whole facility environment from the interior environment.

Table 27

The Rankings of the Frequently Mentioned Interior Environment Themes that Participants Wanted to Improve

Rank	Interior Environment	Count (%)	Rank	Interior Environment	Count (%)
1	Bigger room/space	9 (13%)	11	Cleanliness	2 (3%)
2	Improved privacy	6 (9%)	11	Carpet	2 (3%)
2	More options for food	6 (9%)	11	Temperature control	2 (2%)
4	Better access to staff	5 (7%)	11	Table	2 (2%)
5	Lower noise levels	4 (6%)	11	Openable window	2 (2%)
6	Better bed & pillows	3 (4%)	19	Larger closet	2 (2%)
6	Comfortable chair(s)	3 (4%)	19	Bigger door	1 (1%)
6	TV (channel, position)	3 (4%)	19	Lighting	1 (1%)
6	Lack of personalization	3 (4%)	19	Balanced distribution	1 (1%)
6	Bathroom	3 (4%)	19	Outside/Patio seating	1 (1%)
11	Institutional settings	2 (3%)	19	Radio	1 (1%)
11	Activity programs	2 (3%)	19	Security	1 (1%)
11	Air quality (scent, dry)	2 (3%)	19	Wheelchair	1 (1%)

The most frequently mentioned comment was “bigger room and space” (13%), followed by “improved privacy” (9%) and “more options for food” (9%). The participants wanted bigger room and space than they currently had. They mentioned the current space is too small to bring everything they wanted. In addition, one participant mentioned that he needed more space to get in and out easily with his wheelchair. One participant said that *“There are things I still cannot bring here. I hope my room is bigger than this. I want to put more photo albums on the shelves, put more pictures up, and bring my furniture here.”* Other participants also mentioned that the current space is too small to have their visitors in their room. One participant noted that *“When my family visits me, not everybody can sit here. Only a couple of people can sit, and others should stand for the whole time. So, we usually spend our time in the lobby when more than 3 people visit me. I do appreciate that I have my own private room, but I do wish it could be bigger.”*

The second most frequently mentioned interior environment that the participants wanted to improve was “improved privacy.” The participants, especially those who lived in a shared room, wished to have a private room. Out of six participants desiring an improved privacy, four participants were living in a shared room. To be specific, one participant mentioned that *“I am supposed to have a roommate in this room, but I don’t have one now. I wish there was no roommate in my room. I want my private room, but I know there will be a roommate for sure. I like not having a roommate like now”* In addition, some responses indicated that their privacy was easily violated. One participant said that *“Even though I close my door, someone can always open the door. People sometimes knock on the door and open it at the same time. I have a door to keep my*

privacy, but it can always be disturbed so easily, and that's not privacy!" Moreover, another participant also commented that *"When I take a nap or want to sleep late in the morning, that never goes smooth here, simply because someone enters my room."*

Many of the participants also commented to improve the facility services and support, such as more options for food and better support from their staff members. For example, some participants were dissatisfied with the food options they can take. All the six participants thought that the same food menu was too often repeated, and they wanted to have more variety of the menu. They also mentioned that it would be nice for them to choose what to eat. In addition, the participants also wanted better access to staff so that they could get improved care. The participants sometimes felt there were shortage of staff in the facility and lack of communication among the staff. They wanted to have more staff available throughout the facility. For instance, one participant mentioned that *"I hope there would be more staff/helpers here because I need to wait a significant amount of time for people to help me. When I need some help from them, I press the button near me. However, it takes a long time for someone react my help. I believe all the staff are too busy, so I hope there would be more staff available here."* Another participant said that *"When I ask someone bring something early in the morning, somebody else brings a different thing that I asked in afternoon. I then ask again to bring the right one, then someone else brings it later in the afternoon. They should communicate with each other."*

The participants also wanted to improve noise levels throughout the facility. They complained about the fact that they frequently hear noise from outside the hallway, despite the closed door. Their responses indicated it becomes more annoying when they

are trying to sleep, or they are in the middle of sleep. As the part of the PSQI questionnaire, when they were asked about anything that makes them have trouble sleeping, the most frequent response was noise. One participant noted that:

> *Every night I try to get sleep, I hear somebody talking outside, which is very annoying. I frequently wake up in the middle of the night because of the noise outside. Morning is not different at all. When people start moving outside to take care of other people or prepare our breakfast, all the noise people make wakes me up early in the morning! I can never sleep late in the morning because of the outside noise.*

The participants would love to have a better bed and pillows for themselves. Although there were seven participants who were satisfied with their bed having an extra mattress, three participants wanted to have more comfortable bed and pillows for them. They said good bed and pillows are important for them because they spend most of their time in their bed. In addition, the participant wanted to have more comfortable chair(s) in their room. One participant noted that she would love to have a comfortable chair for her to relax and read books by putting her feet on. Another participant said that the current chair is not bad, but she would appreciate if she can replace it with a more comfortable one.

Three participants mentioned they would love to improve their TV. Two participants wanted more diverse channels to choose from, and one participant wanted to put the TV in a better position and location for better view. Some participants mentioned that they had a lack of personalization due to the limited space they have. They also

wanted to have more personalization on the support they receive from the facility, such as meal plan. In addition, three participants commented about bathroom. Two participants wanted to have more spacious and private bathroom, and one participant thought the surface of the bath tub is too hard for her. Two participants noted that they do not like the institutional settings. One participant said that *"I don't like this institutional setting. I want a more welcoming place. Emotionally, it is not favorable unfortunately."* Another participant also mentioned that furniture in the dining room and living room, especially the dining table, feels too cold and gives so institutional impression.

Furthermore, two participants wished that the facility provides more diverse activity programs they can participate in. The participant also thought the air quality should be improved. One participant mentioned that the scent in the facility is not pleasant. The other participant noted that "*The air is terribly dry, so I had to evaporate something. I tried to use my humidifier, but it is prohibited here. So I ended up having four wet towels in the hanger nearby my bed every night."* In addition, two participants had complaints about temperature control. They mentioned that temperature is hard to control and adjust to make them comfortable both in summer and winter. Two participants mentioned that the facility should more work on for improved cleanliness throughout the facility. Regarding carpet, one participant disliked the carpet flooring, but she understood it would be safe when people fall. Interestingly, another participant noted that *"The carpet should be a lighter color. It is hard to find when I drop something. It is too dark now."*

The participants also hoped to have openable window so that they can let fresh air in, and there were comments to have a bigger table, a larger closet, and a wider door in their room. One participant wanted to improve electric lighting regarding both amount and quality of lighting because she wanted a bright room, but it became very dark at night. In addition, one participant wished there would be more outside seating so that he and his visitors can spend their time there, and other participants wanted to bring a radio and a better wheelchair into their own room. There were also comments about security. To be specific, one participant mentioned that being safe and cared of is important because the people in a long-term care facility are in the situation they need to be cared. Interestingly, one participant mentioned about imbalance of residents' distribution. The person noted that:

> *The floors are not well mixed with healthy and unhealthy people. So, I sometime get depressed by looking at the too sick neighborhood here. I want to see a balance of healthy and unhealthy people being together.*

When the participants were asked about what interior environment they would want to improve in the facility, 40% of them (n=21) said nothing they wanted to change or improve. They mentioned that they were fairly satisfied with the current environment.

DISCUSSION

This chapter will discuss the implications of the results regarding the three research questions in the study. The first set of research questions are "Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' depression in long-term care facilities? (RQ 1)" and "Do the different environmental settings (e.g., distance to a ventilation system, square footage, and building), as effect modifiers, affect residents' depression change? (RQ 1.1)" The second set of research questions are "Does olfactory stimulation via ambient scent environment, as a positive distraction, improve residents' perceived quality of sleep in long-term care facilities? (RQ 2) and "Do the different environmental settings (e.g., distance to a ventilation system, square footage, and building), as effect modifiers, affect residents' perceived sleep change? (RQ 2.1)" Finally the last research question is "Overall, how do residents perceive interior environments in long-term care facilities? (RQ 3)" As mentioned earlier, the study questioned the impact of an ambient scent environment created with lavender essential oil. The research questions included its impact on residents' wellness (i.e., depression and quality of sleep) in long-term care facilities. This study also had questions about any potential impact of moderating variables (i.e., distance to the ventilation system, SF, and the building where the residents reside) on the relationship between lavender scent and residents' wellness. In addition, this study had research questions about how residents perceive their living environment. Based on the results explained in the previous chapter, this chapter will discuss the implications of the findings associated to the research questions in the study.

Ambient Scent Environment

As one of inexpensive and non-invasive CAM methods, aromatherapy has been frequently applied and its positive impacts, especially lavender, on mood has been continuously explored (Ndao et al., 2012; Sánchez-Vidaña et al., 2017). To be specific, recent previous literature reported a positive impact of lavender on people's mood, such as anxiety and depression (Johnson et al., 2016; Karadag et al., 2017). However, the results of the present study showed a placebo effect of ambient scent environment on the residents' depression. To be specific, both intervention and placebo groups had statistically significant decreases in the GDS scores at the follow-up from baseline. In addition, further regression analyses showed no statistically significant interaction effect of the intervention and the baseline depression score.

A placebo effect of lavender aromatherapy has been reported in previous literature (Behmanesh et al., 2011; Chamine & Oken, 2015) To be specific, a recent study found a placebo effect of lavender essential oil on anxiety, in spite of different population in the study (Franco et al., 2016). The authors conducted a randomized study with a placebo control group to explore whether lavender essential oil was effective to reduce female patients' anxiety levels before their breast surgery. The results found that the patients of both the intervention and placebo groups had statistically lower anxiety levels, indicating a placebo effect of lavender essential oil. The authors suggested a placebo effect was involved in terms of the decrease in anxiety among the control group who received non-scent aromatherapy.

Although scholars have a found positive impact of lavender, they also acknowledge the huge possibility of placebo effect or expectancy of improvement (Chamine & Oken, 2015). For instance, the consequences of being exposed to aromatherapy easily accompany with an expectancy of improvement rather than the true impact of the aroma per se (Howard & Hughes, 2008). Additionally, Bent (2000) once described aromatherapy as "an ineffective treatment but an effective placebo", indicating the high chance of placebo effect of aromatherapy. The author further stated that CAM studies are more sophisticated than other studies (e.g., placebo-controlled, RCT, etc.) due to that reason. The notion has been also supported by other researchers because diverse psychological as well as neurobiological results can be extracted by a placebo effect and expectancy of improvement (Benedetti & Amanzio, 2013; Chamine & Oken, 2015; Meissner et al., 2011; Oken, 2008).

What is more, the effect of lavender aromatherapy on people's mood is still debated among scholars. In systematic review papers, more results showing an improvement in mood have been found than the results indicating negative impacts or insignificant differences (Ali et al., 2015; Lee et al., 2011; Yim et al., 2009). For example, one recent study found decreased depression levels among community-living older adults after eight-week aromatherapy (Xiong et al., 2018). However, the authors explored three different aroma scents, including lavender, and the study did not have a placebo group. Conrad and Adams (2012) also found a beneficial impact of lavender essential oil on anxiety and depression among 28 postpartum women; however, the study design did not

include a placebo group either. Therefore, these studies were not able to test a placebo effect, and the positive impact may be associated with a placebo effect.

Placebo-controlled studies have also found a beneficial impact of lavender on people's mood (Lee et al., 2011). To be specific, one study discovered that lavender essential oil improved not only psychological statuses, such as mood, but also physiological statuses, such as blood pressure, heart rate, and skin temperature (Sayorwan et al., 2012). However, the participants in the study were 20 healthy young adults (mean age = 23.25). Another placebo-controlled study also found similar results: improved self-reported mood status and a physiological marker to indicate lower stress levels among 20 young and healthy women (Matsumoto et al., 2014). However, those positive impacts were not found among long-term care facilities residents. Due to the different populations and the experimental settings in these studies, their findings may not indicate necessarily to have the same beneficial impacts in the population and the environment in the present study, which are residents in long-term care facilities. For these reasons, the impact of lavender essential oil on mood is still indeterminate, and the conclusion of its implication should be carefully considered (Lee et al., 2011).

To answer the question about the impact of lavender on quality of sleep, the results of the present study was able to show a positive effect of ambient scent environment on the residents' sleep quality. In other words, only the intervention group had statistically significant decreases in PSQI scores from baseline, whereas the placebo group did not experience improved sleep quality. However, further regression analyses

found no statistically significant interaction effect of the intervention and the baseline depression score.

The results of the present study contribute to the growing evidence that lavender may be effective to improve sleep among residents in nursing homes (Nasiri & Fahimzade, 2017). A recent study randomly assigned 50 nursing home residents into either the intervention group or the placebo group by attaching a small cotton ball to the participants' clothes for seven consecutive nights (10 pm to 6 am). The authors measured the quality of sleep with PSQI and found an improved quality of sleep among the residents who were exposed to lavender scent over the night.

The effectiveness of lavender on sleep among the elderly with dementia also has been investigated (Johannessen, 2013; Takeda, Watanuki, & Koyama, 2017). Johannessen (2013) studied 24 residents with dementia in nursing homes through 12 nursing staff and found positive effects of lavender scent on sleep among the majority of residents. However, the study did not involve the residents' reactions toward the lavender scent, but their reactions were evaluated by nursing staff; therefore, the result should be interpreted with caution. In addition, a recent study supported the previous finding in terms of improved sleep quality due to inhalation lavender scent aromatherapy (Takeda et al., 2017). The authors discovered the statistically longer total sleep time and less early morning awakening in a 20-day intervention period compared to a 20-day control period. However, they did not include a placebo period so the positive result might be associated with a placebo effect.

Similar to the impacts of lavender on mood, its impacts on sleep have been widely explored across the world and people oftentimes use lavender as one type of CAM (Buckle, 2014). To be specific, a recent review conducted in Australia found that aromatherapy, especially lavender, is one of the most prevalent methods to relieve age-related symptoms in aged care facilities (Bowles, Cheras, Stevens, & Myers, 2005). Besides, a recent study recognized that the residents in a nursing home had positive and open attitudes toward aromatherapy (Johannessen & Garvik, 2016). However, contrasting results to the studies, which have suggested lavender scent's beneficial impacts, have led to inconclusive debate among researchers (Lillehei & Halcon, 2014). Furthermore, due to the inadequate methodologies (e.g., small sample size, inconsistent duration, etc.) and the potential bias (e.g., laboratory setting), concluding the lavender impact on sleep should be followed with care and caution (Fismer & Pilkington, 2012; Lillehei & Halcon, 2014).

Like mentioned above, the responses from the post-experimental interview further support the earlier findings of the effectiveness of ambient scent environment. Almost half of the participants in the intervention group expressed their positive experience with the scent: 33% of them had a positive experience in their sleep, and 19% of them experienced a better mood status after exposure to the ambient scent environment. What is impressive from the conversations are the responses indicating an interesting effect on their mood. Two participants in the placebo group expressed that the jar soothed their mood. One mentioned how she liked having it in the room, although she could not notice any exact difference in her mood. The other suggested that she felt better because she frequently talked to the jar during the two weeks. These reactions may be

associated with a positive stimulation into their routine lives in long-term care facilities. Their responses (unaware of the exact reason and difference but feel better) may also indicate some degree of a psychological effect (i.e., an expectancy of improvement) by having the jar. These findings may potentially explain the placebo effect that was found above. However, further studies must be conducted to delve into how residents perceive having a jar in their room and its implication.

In addition, RCT studies (e.g., longitudinal and repeated measures) often use regression analyses, such as linear regression and logistic regression (Rosenblum & van der Laan, 2009; Twisk et al., 2018). Therefore, the present study further looked at the interaction effects of the intervention and other variables (e.g., baseline scores, ventilation distance, SF, and building); however, it was not able to detect any significant measurable interaction effects between the intervention and the moderating variables. In other words, different distance to the ventilation system did not have a statistically significant association with the intervention on the changes in depression or sleep quality. Also, different SF and building had the same results as above.

Not enough variation within the moderating variables may lead to these results. To be specific, each room's configuration (i.e., distance to ventilation and SF) is similar to each other, and the rooms in Building A, especially, had identical layouts. The low value of the standard deviations for both distance to ventilation (ft) (intervention = 1.35, placebo = 1.31) and SF (ft^2) (intervention = 22.77, placebo = 16.36) may indicate these similar layouts across the three buildings (Table 6). Finally, these narrow ranges of variations may not provide enough information to detect the moderating roles on the

impact of lavender scent environment. Even though no statistically meaningful relationship between the built environment and lavender essential oil's impact on mood and sleep was found, this study is the first study to explore the built environments' moderating effect on aromatherapy. Hence, additional research investigating a potential relationship between the built environment and aromatherapy should be desired.

Long-Term Care Facilities Interior Environment

To examine how residents in long-term care facilities perceive their living environment (RQ 3), the participants' responses about what they liked and wanted to improve were analyzed. When quantified, the most frequently mentioned interior environment that the residents liked was 'window and view', followed by 'pictures and photos' and 'TV'. These top three frequently mentioned comments are all associated with positive distractions from the theory of supportive design. The results contribute to the growing evidence that how people perceive healthcare environments through the lens of the theory of supportive design (Devlin et al., 2016). Devlin et al. (2016) asked patients to list three features in their hospital room that are associated with their satisfaction with their stay. 'TV and other media' was the most common comment, followed by 'view and window', 'size of the room', and 'light and sun'. Similar to the present study, the authors also described that the patients commented positive distraction the most frequently (33.2%), followed by perceived control (22.4%) and social support (6.0%).

The findings indicate the importance of positive distraction for people who live in an institutional setting (e.g., long-term care facilities, hospital, assisted living facility, etc.) away from their own house. Because they may focus more on their worries related

to their health conditions, positive distraction can evoke positive feelings and lower stress by shifting negative foci to positive foci (Ulrich, 1991). The effectiveness of nature as a positive distraction has been widely explored in terms of its impact and its positive impact on people with health problems is well known among researchers (Zadeh et al., 2018). Having a nature view in a room is especially important for people who cannot go outside, oftentimes due to their physical restrictions (Brereton et al., 2012). As windows can provide view access, the participants in the study appreciated having a window view in their room and they felt calm by watching the view, especially views of sunsets and sunrises. However, windows also came up in negative comments as well. When they were asked about things they wanted to change, two participants mentioned they wanted control over the window so that they could open the window.

In addition to 'window and view', 'flowers' as well as 'garden and outdoor', which are highly associated with nature, were notably mentioned. For example, the participants loved going outside and having fresh air in the garden area. The participants, particularly in Building A, loved watching ducks in the garden. All the comments related to nature indicated that the participants felt calm and relaxed and got some energy from nature. These responses support the previous findings that the environment providing nature views and natural elements enhanced people's health (Devlin & Andrade, 2017; Zadeh et al., 2018). One of the participants expressed his hope to have more outside patio seating to use when spending time with his family, and this comment indicated how outdoor environment is important not only to residents in a long-term care unit (Kearney

& Winterbottom, 2006) but also to their family members (Evans, Cutson, Steinhauser, & Tulsky, 2006).

The participants also loved having pictures and photos in their rooms. Because residents spend most of their time away from their friends and family, having their loved one's picture nearby their bedside or in the room is a great option for them to alleviate their loneliness (Devlin et al., 2016). Indeed, one study found that looking at a photo of a loved one was effective to lower pain (Master et al., 2009). Therefore, having pictures of friends and family members can be a great positive distraction to enhance their psychological wellness. Moreover, TV can be another great positive distraction for long-term care facilities residents as they spend a significant amount of time in their room. Previous studies showed the effectiveness of TV as a positive distraction (Devlin et al., 2016; R. Ulrich et al., 2003; Ulrich, 1991). Similar to the recent study, although the majority of comments regarding TV were positive, there were some negative comments about TV, which were the location or position of the TV in the room or limited channel options they could make (Devlin et al., 2016). In terms of further investigating the positive distraction of TV, since it has been investigated more frequently in waiting areas than patients' room in hospitals or residents in long-term care units, more studies should further explore the role of TV as a positive distraction.

The responses from the participants also suggested that residents in long-term care facilities consider having perceived control over the environment, which is the second element from the theory of supportive design, as having great importance. To be specific, having a private room and privacy were among the top four frequently

mentioned interior environments that the participants liked. The participants who lived in a private room liked their private bedroom. Furthermore, having bigger room/space and improved privacy were the most frequently mentioned responses when the participants were asked what they wanted to improve. The participants who shared a room with a roommate, especially, desired more privacy. Those responses were highly associated with perceived control perceived control of the environment, and the participants thoroughly described their desire to achieve this control.

Consistent with the findings of the present study, there are studies that also reported the importance of control regarding patients' wellness (Andrade et al., 2017; Williams et al., 2008). Furthermore, the detrimental impact of a lack of control on health (e.g., higher stress levels, higher anxiety, frustration, etc.) has been well documented (Moser et al., 2007; Zadeh et al., 2018). A single-occupancy room can provide residents with a higher degree of privacy as well as control over the environment than a double-occupancy room in shared living facilities. Undoubtedly, people prefer staying in a single-occupancy room rather than a double-occupancy room because they are worried about having their privacy interrupted (Jolley, 2005; Zimring et al., 2004). In explaining why they wanted private rooms, residents specified that they often feel discomfort because they feel a lack of control due to sharing with others (MacAllister et al., 2016). Therefore, the participants in the present study showed their preference of living in a private room or living in a shared room without a roommate because more personal control over the environment and privacy was granted to them in a single-occupancy room (Devlin et al., 2016). However, as the participants mentioned, a single-occupancy

room does not always provide privacy because anyone can easily enter the room. This unexpected and unwilling interruption may disturb people's relaxation and provoke stress.

Besides comments about private space, many participants appreciated an ability to personalize their room (e.g., bring their personal items, such as pictures, flowers, an extra bed mattress, a chair, etc.) while some participants still wanted to have more opportunity to make their room personalized. In addition, some participants preferred to have more space to bring more of their own personal items (e.g., pictures, chairs, cloth, etc.). They used to have control over the majority of things when they lived in their own space. In contrast with their home, they usually had a very limited range of perceived control since they were away from their own house and lived in a shared facility. Hence, having desire to make a room as home-like environment is common among inpatients (O'Connor et al., 2012), and patients perceived a home-like environment as a healing space (MacAllister et al., 2016). By bringing personal belongings to personalize their space, patients were more satisfied with their facility and they were able to create their own healing environments (Evans et al., 2006; MacAllister et al., 2016). For these reasons, a greater number of comments from the participants were deeply associated with personalization to create a space showing their own identity and home-like environment. In addition, some participants wished that the environment could be improved to mitigate an institutional setting and to be more a home-like environment.

The participants also wanted the environment to provide comfortable indoor environmental qualities (e.g., acoustic conditions, cleanliness, indoor air quality, lighting

conditions, and thermal conditions) and control over those qualities. The importance of ambient sensory environment and control over the environment in a healthcare setting has been thoroughly described among researchers, and they have agreed on the beneficial impact on people (e.g., patients, staff, and visitors) (Salonen et al., 2013; Schweitzer et al., 2004; Zimring et al., 2004). A recent review paper well summarized that an ambient sensory environment can especially lower patients' aggressive behaviors and enhance their mood and satisfaction, whereas uncomfortable sensory environment can hinder patients' wellness (e.g., mood, satisfaction, and physical health conditions) and downgrade their quality of life (Zadeh et al., 2018). Among the participants, the most common complaint about indoor environmental qualities was acoustic conditions. They complained that the environment was too noisy to get enough sleep and to relax and wanted to lower acoustic levels. They also complained about dry air, inconsistent temperature or a lack of temperature control, cleanliness, and lighting in the environment. Since undesired sound disturbance (Marquardt, Bueter, & Motzek, 2014), insufficient lighting (Shepley et al., 2012), and unsatisfied with thermal conditions (Garre-Olmo et al., 2012) can lead to detrimental health statuses, providing enough control over the environmental qualities is important to increase residents' wellness.

Lastly, the responses from the participants also pointed out the critical value of receiving enough social support from others, which is the last element from the theory of supportive design. The participants liked an environment that included having easy access to staff, and some participants wanted better access to their staff members. In addition to having a supportive access to staff, they also wanted to have enough space to

spend time with their visitors for their social interactions. Having abundant social support from others can expedite patients' healing progress and help them have steady and relaxed psychological status (Rigby, Payne, & Froggatt, 2010). A healing environment can promote social support from a loved one of residents in long-term care facilities by equipping appropriate items to accommodate their visitors (e.g., extra bed, phone, patio seating, etc.) (Carpman & Grant, 2016; Devlin & Andrade, 2017). Through the environment fostering social support from their visitors, residents and patients can fulfill their emotional needs (Bolger & Amarel, 2007) and soothe their loneliness (Brereton et al., 2012). Moreover, easy access to staff via higher transparency can also increase communication between staff and patients (Gardiner, Brereton, Gott, Ingleton, & Barnes, 2011), which can further reinforce patients' satisfaction with the quality of care and lower patients and their family's anxiety levels (Salonen et al., 2013; Zimring et al., 2004).

In conclusion, the responses about the interior environment of long-term care facilities support the theory of supportive design. The participants' responses indicated the importance of perceived control, social support, and positive distraction in the environment. All of the three elements in the theory are highly associated with the participants' satisfaction with the environment. In addition to the three elements, the participants also considered other elements as important for them (e.g., more diverse food options) which can also benefit the participants. As the previous literature also pointed out that there are some areas which the theory does not cover (Devlin et al., 2016), more studies must be carried out to expand the theory so that it can be applied to future studies with inclusive perspectives.

Limitations and Recommendations

Unfortunately, this study has significant limitations, just as many other studies conducted on the impact of ambient scent environment. First of all, as a single-blind study, this present study design has a limitation regarding observer bias because only the participants did not know the allocation and the investigator knew the participant allocation. Since the data were collected through one on one conversation between a participant and the investigator, blinded participants' responses might be affected by the interaction with the investigator. A single-blind was evitable because only one investigator was available for the entire study process (e.g., recruitment, data collection, and data analysis). Moreover, even though the post-experimental interview did not find any participants who noticed that they were assigned to the placebo group, few participants mentioned they could not smell anything. Hence, whether or not they remained blinded throughout the study is still questionable.

Secondly, not having a control group, which did not receive any treatment at all, may be problematic regarding representativeness since the participants were only randomly assigned to either the placebo or intervention group. Because they already agreed to participate in the study and signed the consent form, they may have favorable opinion on ambient scent environment. Therefore, future studies can be conducted as at least double-blind with three groups allocation (i.e., control, placebo, and intervention groups) to minimize potential observer bias and to increase representativeness of the participants.

The third limitation is the small number of participants recruited for this study. The study met the statistical power at the baseline (N=58), however, only 42 participants were analyzed at the follow-up. Therefore, the statistical power of the results had been threatened. If more participants were recruited and analyzed, the results could be different with the findings of the present study. In addition, the participants were recruited in three different buildings from two different long-term care facilities. Although the participants were randomly assigned to either group by using a stratified randomization, many potential confounders exist due to the different environmental settings (e.g., service, building layout, staff, etc.). Moreover, the deviation for each environmental setting (e.g., distance to the ventilation and SF) was too small across the participants to investigate the moderating role of built environment on the impact of ambient scent environment. Accordingly, future studies can delve more into the topic with a larger number of participants in a single facility. In addition, more studies on the relationship between an interior environment and the impact of ambient scent environment are warranted.

Another limitation of this study is that any possible other environmental factors associated with the dependent variables (i.e., depression and quality of sleep) were not considered. For example, the number of family visits may be associated with the depression levels and noise levels from outside hallway may be directly related with the quality of sleep. However, the present study did not collect any other environmental factors. Thus, future research should future investigate the probable impacts on residents' wellness.

The intensity of dilution can be the fifth limitation. For this study, 1% dilution was used with the lavender essential oil because less than 2% dilution is preferred for elderly (Worwood & Worwood, 2012). However, 1% dilution may not be strong enough to find out the impact of the lavender scent. Indeed, four participants in the intervention group mentioned that the scent could be stronger. If they had stronger dilution for the study, they might have different results from the present study. As no standard regarding dilution is available in practice yet (Sánchez-Vidaña et al., 2017), future studies should additionally explore setting a standard regarding dilution and then investigate the impact of different dilution on wellness.

In addition, conversation about the participation among residents may lead to a potential bias. When a participant talks about any positive experience of ambient scent environment to another participant, the conversation may affect the other participants' thoughts. For this reason, by sharing their experience together, the results may contain a potential bias.

The last limitation of this present study is that the reliability of the measurement tools and validity of the open-ended questions may be controversial. Despite the well-known tool for quality of sleep, which is PSQI, with high reliability and validity, the two-weeks recall period may lead to recall bias especially among the older populations. In addition, some questions from PSQI are hard to answer (e.g., how often have you had trouble sleeping because you *cough or snore loudly?*). For these reasons, future studies can measure participants' mood and quality of sleep with an additional objective measurement. Furthermore, the open-ended responses were coded and analyzed by a

single investigator. Hence, the validity of the coding and themes were not able to be tested and calculated as the internal validity.

Concurrently, future studies should focus on the impact of ambient scent environment as overcoming the limitations mentioned above. A rigor of the previous studies concerning ambient scent environment has been often critiqued by researchers, and this methodological limitation has made researchers uncertain of the impact of an ambient scent environment and be cautious with the findings from the previous literature. Therefore, the impact of ambient scent environment on people's wellness is still inconclusive among scholars. Forthcoming research conducted with a methodological rigor should build on the current literature review by addressing the limitations mentioned from this present study.

In addition, the majority of studies about an ambient scent environment have been conducted in medical fields rather than design fields. One of the considerable problems in the interior design field is a lack of theory within the field, which is leading to limited studies developed from theoretical frameworks. Future studies should be developed from a theoretical framework in the interior design field and should focus more on the impact of ambient scent environment from interior design perspectives. In conclusion, those efforts can enhance the current literature in interior design discipline as well as contribute theory building within the field.

CONCLUSION

Demographic trends show an increase in ageing population (National Center for Health Statistics, 2013). For example, in 2050, the number of adults older than 65 years old will be double that of 2015 and more than one fifth of them will be older than 85 years old (National Center for Health Statistics, 2013). A number of the older population resides in long-term care facilities in the United States, and the number is slightly growing over decades (Centers for Disease Control and Prevention, 2016). The problem among the residents in long-term care facilities is that people who live in institutional settings are more likely to suffer from psychological disorders than people who live in non-institutional settings (Seitz et al., 2010). One of the prevalent psychological disorders among long-term care facilities residents is depression and many of them have shown depressive symptoms (Barca et al., 2010). Depression in a late-life stage is complicated to treat because diverse and complex factors (e.g., health condition, social support, physical and mental status, etc.) lead to depression (Chen et al., 2014). Residents' quality of sleep is frequently disturbed in institutional settings because they sometimes share a room with a roommate and nursing staff are working outside the hallway by making some noise (Zimring et al., 2004).

To cope with the depressive symptoms and to promote better quality of sleep, ambient scent environments (i.e., aromatherapy) are getting popular among people who are worried about any side effects of traditional medicines (Sánchez-Vidaña et al., 2017). Aromatherapy, especially, has been frequently used to enhance people's wellness, as an inexpensive and non-invasive CAM (Ndao et al., 2012). The recognized major benefits of

lavender scent environment are improved quality of sleep and better mood. In addition, healthcare facilities can lower people's stress levels by providing three conditions (i.e., a sense of control over the environment, social support, and access to positive distractions). Having an ambient scent environment can soothe people's feeling as shifting their attention to restorative aspects of the non-medical world. Therefore, this study explored the impact of an ambient lavender scent environment, as a positive distraction, on depression and quality of sleep.

A single-blind and randomized placebo-controlled study was conducted to see the impact of an ambient lavender scent environment and a post-experimental interview was conducted to explore how the participants perceive the long-term care facility environment. The results indicated a placebo effect of an ambient scent environment on depression as both intervention and placebo group had improved depression levels at follow-up from the baseline. On the other hand, the findings implied a positive impact of ambient scent environments on quality of sleep since only the intervention group had an improvement on sleep quality. However, there was no measurable impact of the interaction effect between the baseline score and the assigned group (i.e., intervention and placebo group) on the follow-up score. In addition, when moderating impacts of the built environment (e.g., distance to the ventilation system, SF, and different buildings) were analyzed, no statistically significant impact was found.

In another section of the study, the participants listed the interior environment they liked and wanted to improve. They liked the outside view through the window the most, although some of the participants would have preferred if they could open the

window. In addition, they liked nature elements, such as flowers in their room and the outdoor garden. Some of them wanted to have more seating in the garden so that they could enjoy the outside with their visitors. The participants also appreciated the ability to personalize their own room by bringing pictures and photos. However, some participants still wanted to have more freedom to personalize their room and a bigger space to bring more items into the room. They liked TV as well since they spend most of their time in their room watching TV, but some people wanted more broadcast channels and better location for the TV. The participants also liked to have their private room to keep their privacy; however, several participants said their privacy was frequently interrupted by other people.

These responses well support the theory of supportive design by indicating the importance of three conditions (i.e., perceived control, social support, and positive distraction). Throughout the interviews, the participants desired to have a sense of control over the environment, such as personalizing their room (i.e., bring their personal items), controlling temperature, having openable windows, etc. However, they wanted to have a bigger room so that they could personalize them more and better control noise levels and interrupted privacy. The participants also wanted to have easier access to get social support from the staff as well as their visitors so that they can get better support from the staff and spend their time with their loved ones. Lastly, the answers from the participants revealed their wish to have diverse positive distractions. TV, flowers, outdoor gardens, and diverse activity programs are the examples they liked from the facility. The

identification of these items is meaningful, as these can be categorized as things that help shift focus from worrisome thoughts to other things.

Given the limitations of the present study, the favorable impacts of ambient scent environment on residents in long-term care facilities should be further explored. Due to the inconclusive debates on ambient scent environment and inconsistent findings from studies with underdeveloped/weak methodologies and study designs (Fismer & Pilkington, 2012; Lee et al., 2011; Yim et al., 2009), researchers urge people to be careful about applying an ambient scent environment as a treatment method (Lillehei & Halcon, 2014). For these reasons, more methodologically sound research must be conducted to find out the impact of ambient scent environment on human beings. Furthermore, more rigorous future studies exploring the effectiveness of ambient scent environment are critical to inform people of potential advantages from it. For example, as an inexpensive and non-invasive CAM, many people may easily get benefits to enhance their health status as creating an ambient scent environment for them.

Lastly, future studies can focus more on interior environment perspectives regarding the impact of ambient scent environment as developed from theoretical frameworks. The present study has a limited variation in interior environment so the potential effect of different interior environment on ambient scent environment was unable to be explored. By investigating a wide variation in interior environmental factors, future studies can delve into the role of built environment in experiencing potential benefit of ambient scent environment. All things considered, more studies with a

methodological rigor can contribute the current interior design literature through interdisciplinary perspectives.

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APPENDICES

Appendix A

IRB Approval Letter

Suyeon Bae <baexx119@umn.edu>

STUDY00001849 has been approved

ethosirb@umn.edu <ethosirb@umn.edu> Thu, Mar 22, 2018 at 3:14 PM
Reply-To: ethosirb@umn.edu
To: baexx119@umn.edu

Template:IRB_T_Post-Review_Approved

Notification of Approval

To:	Suyeon Bae
Link:	STUDY00001849
P.I.:	Abimbola Asojo
Title:	The Impacts of Ambient Scent Environments on Residents' Wellness in Nursing Homes
Description:	This submission has been approved. You can access the correspondence letter using the following link: Correspondence_for_STUDY00001849-1.pdf(0.03) To review additional details, click the link above to access the project workspace.

Appendix B

Consent Form

CONSENT FORM

Suyeon Bae, PhD Candidate, College of Design, University of Minnesota,
Study Number 0001849

The Impacts of Ambient Scent Environments on Residents' Wellness in Nursing Homes

You are invited to participate in a research study about the space you live and your thoughts about your experience. This study tries to have at least 58 participants for this study, and you are selected as a possible participant because you live at Episcopal Homes.

Procedures
If you agree to be in this study, you will be asked to answer my interview questions twice. After first interview, I will place a glass jar having a scent. Two weeks later, I will come back and ask second interview questions. I will ask you about your experience with the scent and the space you live. I will not ask you to share any confidential information about you.

Risks and Benefits of Participating in the Study
The degree of risk in this study is equivalent to your daily experience of living in your room. However, according to National Institutes of Health, if you have allergies to lavender oil or scent, you may experience some side effects like headache, nausea, and vomiting. Therefore, if you have any allergies, you will not be eligible to participate in this study. If you experience those symptoms during your participation, you can always stop having the jar in your room.

We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include that you may have difference experience, and I am going to ask you two weeks later about the experience once you participate in this study. Also, your participation will be very helpful for researchers to better understand the impacts of lavender oils. There are no direct benefits to you for participating in the study.

Compensation
There will be no monetary compensation for participation in this research. Also, participation to this study is completely free.

Confidentiality
The records of this study will be kept private. In any sort of report, we might publish, we will not include any information that will make it possible to identify you as a participant in this study. Research records will be stored securely and only researchers will have access to the records. Study data will be encrypted according to current University policy for protection of confidentiality.

Voluntary Nature of the Study
All participation in this study is completely voluntary. The decision of whether or not to participate in the study will not affect your relations with the U of M. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships. Again, if you want to leave the study, please contact me or any nurses here. You can always stop having the jar in your room.

Contacts and Questions
The researcher conducting this study is: Suyeon Bae. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at 240 McNeal Hall, 1985 Buford Ave, St. Paul, MN, 55108, baexx119@umn.edu. The researcher's primary academic adviser, Dr. Abimbola Asojo, can be reached at 240 McNeal Hall, 1985 Buford Ave, St. Paul, MN, 55108, aasojo@umn.edu. If you have any questions or concerns regarding this study and would like to discuss with someone other than the researcher(s), **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455, or phone (612) 625-1650.

Participant signature _____ Date _____

Appendix C

Data Collection Script

1. Baseline Data Collection
Hello!

I am Suyeon Bae, a student at the University of Minnesota! I am studying your living spaces and your experience here. Can I check with you one thing very quickly? [If residents say yes, hand the glass jar to the resident] Can you smell this? [If residents say yes, continue; if residents say no, discontinue] Can you tell me what the scent is? [If residents say similar to "lavender", they will be eligible for this study and the study can be continued with the resident] Great. Thanks!

So, I will explain little bit more about my study. It is about the relationship between scent and people's experience. In this study, [showing a glass jar] I will place this small jar with scent next to your bed for 2 weeks. After 2 weeks, I will take the jar back and ask you some questions about your thoughts about your experience during the 2 weeks. If you don't feel comfortable or you don't like the scent, you can always stop having the jar in your room. Also, if you don't want to answer some of the questions, you can always skip those questions. Are you interested in this study?

[If residents say yes, continue; if residents say no, discontinue]
Good, thank you so much for your interest! One more thing, can you write your name or sign on this form about your agreement of being a part in the study? [Read thoroughly the consent form to residents]

Before I leave the jar in your room I'd like to ask you some questions. [Start with the Geriatrics Depression Scale. If residents answer "yes" to more 10 out of 15 questions, discontinue; otherwise, continue with the Pittsburg Sleep Quality Index]

Okay! That's all the questions I have for you today! As I told you, I will place this jar here [within 18 inches from the bed side] for two weeks. I will come back 2 weeks later and ask the same questions I asked you today. However, if you don't like the scent in your room, you can always ask to remove the jar, okay? I will visit here once a day, and a nurse is here all the time. So, you please let your nurse or me know if you have any questions or concerns, Okay? Thank you!

Before I leave today, do you have any questions?
[If yes, answer the questions; if no, thank the resident and leave the room.]

2. Follow-up Data Collection
Hello! How are you?

It has been 2 weeks since I put the jar in your room, and today is the last day to have this jar. Before removing this jar, I will ask you some questions.
[Start with the Geriatrics Depression Scale and continue with the Pittsburg Sleep Quality Index]

Okay! Now I will ask four more questions. For those questions, you can say anything you think of. There are no right or wrong answers, but I want to hear your thoughts! So please share what you think!
[Ask four open-ended questions. What are they?]

So, that's all I have for this study. This study is about learning whether a scented environment affects your mood and quality of sleep. Another part of this study was about learning your thoughts about your living spaces here. Do you have any questions about this study?

Thank you so much for your participation. It really means a lot. Without your help and participation, this study would probably not be successful. Thank you so much!

If you have any questions later, please let your nursing staff know. They will connect you with me again.

Thanks a lot!

[Leave the room]

Appendix D

Instrument – Baseline

Baseline

[GDS-Short Form]

Please indicate how you have felt over the past week:

1. Are you basically satisfied with your life?	Yes / No
2. Have you dropped many of your activities and interest?	Yes / No
3. Do you feel that your life is empty?	Yes / No
4. Do you often feel bored?	Yes / No
5. Are you in good spirits most of the time?	Yes / No
6. Are you afraid that something bad is going to happen to you?	Yes / No
7. Do you feel happy most of time?	Yes / No
8. Do you often feel helpless?	Yes / No
9. Do you prefer to stay at your room, rather than going out and doing new things?	Yes / No
10. Do you feel you have more problems with memory than most?	Yes / No
11. Do you think it is wonderful to be alive now?	Yes / No
12. Do you feel worthless the way you are now?	Yes / No
13. Do you feel full of energy?	Yes / No
14. Do you feel that your situation is hopeless?	Yes / No
15. Do you think that most people are better off than you are?	Yes / No

[PSQI-Modified Version]

During the past two weeks,

1. How long (in minutes) has it taken you to fall asleep each night?	_____
2.A. How many hours of actual sleep did you get at night?	_____
2.B. How many hours were you in bed?	_____

3. During the past two weeks, how often have you had trouble sleeping because you	Not during the past two weeks	Less than once a week	Once or twice a week	Three or more times a week
A. Cannot get to sleep with 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
4. During the past two weeks, how often have you had trouble staying awake while eating meals or engaging in social activity?				
5. During the past two weeks, how much of a problem has it been for you to keep up enthusiasm to get things done?				
6. During the past two weeks, how would you rate your sleep quality overall?	Very good	Fairly good	Fairly bad	Very bad

Instrument – Follow-up

Follow-up

[GDS-Short Form]

Please indicate how you have felt over the past week:

1. Are you basically satisfied with your life?	Yes / No
2. Have you dropped many of your activities and interest?	Yes / No
3. Do you feel that your life is empty?	Yes / No
4. Do you often feel bored?	Yes / No
5. Are you in good spirits most of the time?	Yes / No
6. Are you afraid that something bad is going to happen to you?	Yes / No
7. Do you feel happy most of time?	Yes / No
8. Do you often feel helpless?	Yes / No
9. Do you prefer to stay at your room, rather than going out and doing new things?	Yes / No
10. Do you feel you have more problems with memory than most?	Yes / No
11. Do you think it is wonderful to be alive now?	Yes / No
12. Do you feel worthless the way you are now?	Yes / No
13. Do you feel full of energy?	Yes / No
14. Do you feel that your situation is hopeless?	Yes / No
15. Do you think that most people are better off than you are?	Yes / No

[PSQI-Modified Version]

During the past two weeks,

1. How long (in minutes) has it taken you to fall asleep each night? _____
2.A. How many hours of actual sleep did you get at night? _____
2.B. How many hours were you in bed? _____

3. During the past two weeks, how often have you had trouble sleeping because you	Not during the past two weeks	Less than once a week	Once or twice a week	Three or more times a week
A. Cannot get to sleep with 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
4. During the past two weeks, how often have you had trouble staying awake while eating meals or engaging in social activity?				
5. During the past two weeks, how much of a problem has it been for you to keep up enthusiasm to get things done?				
6. During the past two weeks, how would you rate your sleep quality overall?	Very good	Fairly good	Fairly bad	Very bad

Instrument – Post-Experimental Interview

Follow-up

[Post-Experimental Interview]

1. How did you like the smell from the glass jar? Did you like the scent?

2. Do you think exposure to the smell from the jar is helpful for your health? Do you see any improvements? Do you have any positive experiences of it? Do you have any negative experiences of it?

3. Please list three things in the interior environment of your facility you like.

4. Please list three things in the interior environment of your facility you will like to change.