RANDOMIZED CLINICAL TRIALS EVALUATING THERAPEUTIC INFLUENCES OF ORNAMENTAL INDOOR PLANTS IN HOSPITAL ROOMS ON HEALTH OUTCOMES OF PATIENTS RECOVERING FROM SURGERY

by

SEONG-HYUN PARK

B.A., Dongguk University, Korea, 1999
M.S., Kansas State University, 2002

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Horticulture, Forestry and Recreation Resources
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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ABSTRACT

Medical and psychological responses of patients recovering from surgery were evaluated in hospital rooms with ornamental indoor plants. Three clinical studies were conducted in two hospitals with 80 thyroidectomy patients, 90 appendectomy patients, and 90 hemorrhoidectomy patients. Patients in each surgical procedure were randomly assigned to either control or plant rooms. Eight species of foliage and flowering plants were placed in the hospital rooms during the recovery period following surgery until discharge. Data collected from each patient included length of hospitalization, analgesics used for postoperative pain control, vital signs (blood pressure, temperature, heart rate, and respiratory rate), ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ). Effects were assessed by analysis of covariance and the exact chi-square test.

Patients in the plant rooms had significantly more positive health outcomes than those in the control group with no plants. Patients exposed to plants experienced shorter hospitalizations, fewer intakes of postoperative analgesics, more positive physiological responses, and less pain, anxiety, and fatigue than patients in the control group. Patients with plants also felt more positively about their rooms and evaluated them with higher satisfaction as compared to those in the control group. Based on patients' comments, plants brightened up the room environment, reduced stress, and also conveyed positive messages of the hospital caring for patients. Findings of this study confirmed the therapeutic value of plants in the hospital environment as a noninvasive, inexpensive, and effective intervention for surgical patients in a general hospital ward. Outcomes of this study will substantially affect patients' and hospital administrators'

decisions that indoor plant intervention can foster improved medical outcomes, increase satisfaction with providers, and be acceptably cost effective as compared to other alternatives.

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DEDICATION

This dissertation is dedicated to my father, Joong-Choon Park, who first opened my eyes to the "human" aspects of horticulture, to my mother, Sung-Ja Lee, who gave me so much in love, and to my husband, Chang-Su Kim, who is my best friend ever.

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INTRODUCTION

A hospital can be a stressful place for all user groups, including the medical staff, patients, family members, and visitors. Among the users, surgical patients might be the most vulnerable populations in the hospital due to coping with the stresses of physical pain, discomfort, and other negative symptoms of illness or treatments in which their equilibrium is disrupted and normal coping resources are threatened. At the same time, surgical patients have to deal with other stresses such as worries about their illness, isolation from family and friends, fear of medical procedures, and lack of familiarity with medical personnel, hospital equipment, and the sterile hospital environment (Carpman and Grant, 1993; Carver, 1990; Lipowski, 1970; Moos, 1979; Sommer & DeWar, 1963; Veitch and Arkkelin, 1995; Zimring et al., 1987).

Both major and minor stresses are linked with variety of emotional, psychological and physical health problems (Brown and Harris, 1989; DeLongis et al., 1982; Zarski, 1984). Stress has been associated with anxiety, depression, neurotic impairment, and other psychological symptomatology (Brown and Harris, 1989; Dohrenwend and Dohrenwend, 1974, 1978; Hollister, 1983; Rodin and Voshart, 1986). Stresses require energy and prolonged stress contributes to fatigue (Aistars, 1987; Irvine et al., 1991). Stresses also weaken the body's immune system, increase susceptibility to infectious disease, and delay wound repair (Kiecolt-Glaser et al., 1995; Marucha et al., 1998; Padgett et al., 1998), resulting in slower and more complicated postoperative recovery (Cohen and Williamson, 1991; Cohen et al., 1986; Falk and Woods, 1973; Johnston, 1988; Johnston and Wallace, 1990; Liebeskind, 1991; Mathews and Ridgeway, 1981; Stone et al., 1992).

Some of the postoperative problems related to stress can be mediated through anesthetic intake (Abbott and Abbott, 1995; Gil, 1984; Johnston, 1988; Markland and Hardy, 1993). Abbott and Abbott (1995), however, noted that the side effects of various anesthetics, muscle relaxants, and narcotics may include a number of the postoperative behavioral problems such as vomiting, headaches, nausea, and pain at the incisional site. Higher doses are likely to increase the severity of symptoms. A number of studies showed that greater self-reported anxiety and stress are typically related to more severe postoperative pain (Johnston, 1988; Mathews and Ridgeway, 1981). Pharmacological pain reduction has meant decreased human suffering related to postoperative pain. However, the most powerful analgesic drugs such as strong painkillers (opioids) also have side effects, which can be addictive and even fatal if not properly administered. Further, this approach can contribute to increased drug dependency (Coniam and Diamond, 1994). Therefore, it would be useful to develop nonpharmacologic approaches to improving the patient experiences with pain and stress during hospitalization.

To promote speed of postoperative recovery and to improve quality of life during hospitalization, it is important to provide patients not only the best treatment possible, but also remove such sources of stress and counter them with positive distractions in an environment, which produce soothing and stress-reducing effects. Psychological manipulations, such as positive distraction, have been recognized as effective alternative cognitive strategies to cope with pain and stress (Croyle and Uretsky, 1987; Fernandez, 1986; Fernandez and Turk, 1989; Hodes et al., 1990; Johnson et al., 1998; Lautenbacher et al., 1998; Levine et al., 1982; McCaul and Haugtvedt, 1982; Pennebaker and Lightner, 1980; Tan, 1982; Turk et al., 1983; Tusek et al., 1997; Williams and Kinney, 1991). Ulrich (1992) also discussed the importance of positive distraction on reducing patients' stress and promoting their health and well-being. He defined a positive distraction as “an element that produces positive feelings, effortlessly holds attention and interest, and therefore may block or reduce worrisome thoughts (Ulrich, 1992, p.24).” He claimed that the most effective of these distractions are “(1) nature elements such as trees, plants, and water; (2) happy, laughing, or caring human faces; and (3) benign animals such as pets (Ulrich, 1992, p.24)”. Among these elements, he puts great emphasis on nature/plants (Ulrich, 1991).

The significant correlation between positive emotional states and pain/stress-reducing effects has also been well documented (Croyle and Uretsky, 1987; De Wied and Verbaten, 2001; Langer et al., 1975; Pennebaker, 1982; Salovey and Birnbaum, 1989; Stevens et al., 1989; Zelman et al., 1991). These studies suggest that positive emotions ameliorate pain and stress because subjects evaluate a pain/stress stimulus as less negative or threatening, or because they feel more competent to cope with it. Positive emotional states can also be an important determinant of recovery from illness.

One of the simple and cost effective ways to improve patients’ emotional states and to provide relaxation might be simply providing plants or other natural elements, which provide ample involuntary attention, yet are restorative. Psychophysiological studies in horticultural therapy suggested that a plant environment seems to provide the preferred form of physiologically measurable stress reduction (Chang and Chen, 2005; Coleman and Mattson, 1995; Doxon et al., 1987; Kim and Mattson, 2002; Liu et al., 2003, 2004; Lohr et al., 1996; Owen, 1994; Park, 2002; Park et al., 2004; Tomono, 2003; Ulrich et al., 1991; Verderber and Reuman, 1987). This relaxation occurs remarkably quickly, almost within minutes (Ulrich, 1992; Ulrich and Simons, 1986). People in a plant environment not only showed faster physical recovery from stress, but also improved psychological (Kaplan, 2001; Kaplan and Kaplan, 1995;

Ulrich, 1979), emotional (Adachi et al., 2000; Chang, 2000; Cho, 2002; Kim and Mattson, 2002; Owen, 1994; Park, 2002; Tomono, 2003; Ulrich, 1981, Ulrich et al., 1991; Yamane et al., 2004), and cognitive states (Cimprich, 1993; Hartig et al., 1991; Liu et al., 2003, 2004; Tennessen and Cimprich, 1995). Importantly, studies have shown that viewing plants is linked to positive health outcomes of individuals, such as pain reduction, less need for analgesics, and faster recovery from surgery (Diette et al., 2003; Lohr and Pearson-Mims, 2000; Park, 2002; Ulrich, 1984; Ulrich et al., 1993). There are certainly extensive evidences that the presence of plants and flowers in a hospital improves a sterile hospital environment, enhances patients' healing process, and improves their well-being (Cooper Marcus and Barnes, 1999; Gerlach-Spriggs et al., 1998; Hartig et al., 1999; Parsons et al., 1994; Ulrich, 1999; Ulrich and Parsons, 1992).

Colorful, cheerful fresh flowers and blooming or green plants could be good medicine for patients. The presence of plants and flowers helps to brighten the hospital environment and creates an attractive and restorative atmosphere. They provide soothing and inviting opportunities to get away from the stress inside of a hospital setting. Plants uniquely restore people to physical, psychological, and emotional well-being. Whether indoors or outdoors, plants have therapeutic value. They provide a comfortable and restful retreat not only to patients who undergo a life crisis, but also any occupants spending their time in a stressful hospital environment.

OBJECTIVES

This research investigated how patients are able to utilize plants for their recovery using a multi-modal combination of medical and psychological measurements. The objectives of this research were to compare patients' stress-reducing and recovery effects from their surgery in response to the presence of plants or no plants in their hospital rooms.

The following research hypotheses were studied:

1) Therapeutic influences of plants will reduce pain, anxiety, and fatigue responses as indicated by lower ratings of pain intensity, pain distress, anxiety, and fatigue.
2) Therapeutic influences of plants will facilitate faster recovery as indicated by shorter hospitalization, fewer intakes of postoperative analgesics, and more positive physiological responses.
3) Therapeutic influences of plants will induce more positive psychological responses and evaluation of their hospital room environment.

RESEARCH PROTOCOLS

The Committee on Research Involving Human Subjects at Kansas State University approved this research study outlined in proposal number 3524 on May 2005. The Committee on Research Involving Human Subjects at Gyeongsang National University Hospital and at Bando Hospital also approved this research study on April 2005. The investigator completed training for research involving human subjects.

LITERATURE REVIEW

HUMAN ATTRACTION TO NATURE/PLANTS

The intuitively based beliefs that contact with nature/plants is effective in fostering psychological well-being and producing restoration or recovery from stress are very old as defined in many cultures. Why are plants and other natural environments so highly valued to human beings? In order to form the basic contextual and theoretical basis for this dissertation, it is important to explore and understand theories, hypotheses and perspectives, which attempt to explain human attraction to nature/plants.

Overload and Arousal Theories

The simplest theories explaining human attraction to nature/plants are the overload and arousal theories, advanced by social scientists (Berlyne, 1971; Cohen, 1978; Mehrabian and Russell, 1974; Thayer, 1989). These theories are somewhat different, however, as both propose that human beings are overwhelmed and perceive tension and fatigue, or lead to detrimentally high levels of psychological and physiological excitement from modern environments with high levels of noise, visual complexity, intensity, and movement.

To avoid permanent damage, it is necessary to engage in environment that restores spent energy. According to these theories, surroundings dominated by vegetations, which have less complex and arousal-reducing properties as compared to urban settings lacking nature/plants, have a stress reduction or restorative influence.

Learning and Cultural Theories

Learning and cultural theories explain human attraction to nature/plants in terms of nurture, that is, our positive responses to them are a result of our learning experiences or cultures in which we were raised (Lyons, 1983; Tuan, 1971). According to learning theory, individuals learn positive association with natural environments during vacations and other recreational experiences, while learning negative association with urban environments experiencing such negative phenomena as crime, noise, traffic congestion, or air pollution.

Cultural theory explains that people's responses with respect to environmental elements are conditioned within society, therefore, individuals in different societies prefer or dislike different environmental elements (Moore, 1979; Moore and Golledge, 1976; Tuan, 1974, 1975). If nature has meaning, it is because society has conditioned individuals to ascribe meaning to it. This theory could be used to explain, for example, why many French prefer topiary, or why Americans prefer foundation plantings and grass lawns in their front yards (Jackson, 1982; Schroeder and Green, 1985).

Learning and cultural theories, however, do not explain why people from different geographical and cultural backgrounds have broad similarities in terms of preferences on plants and other nature, and beliefs in the restorative influences of nature/plants (Hull and Revell, 1989; Kaplan and Herbert, 1987; Kwok, 1979; Shafer and Tooby, 1973; Wellman and Buhyoff, 1980; Zube, 1984).

Biophilia Hypothesis and Evolutionary Theories

In trying to understand why human beings feel so drawn to plants and other nature, some have espoused the biophilia hypothesis and evolutionary theories in which our physiological and psychological responses to nature/plants are a result of evolution.

The biophilia hypothesis was proposed by biologist E.O. Wilson (Wilson, 1984). The term 'biophilia' was defined as the "innate tendency to focus on life and life like processes (Wilson, 1984, p.1)." This approach proposed to explain the human attraction for nature/plants that there is a genetic basis for our positive response to nature and vegetation. Unthreatening natural environments had significance for the survival of our early ancestors during evolution. According to biophilic explanation, a human dependence on nature/plants is associated with not just primary necessities such as food, water, and shelter, but also as a source of emotional, cognitive, aesthetic, and even spiritual development (Wilson, 1993).

In perspectives of evolutionary theory, there are at least three prominent evolutionary approaches to human attraction for nature/plants: the Orians' savanna theory, the Kaplan and Kaplan's functional-evolutionary theory, and the Ulrich's psycho-evolutionary theory.

The Orians' evolutionary approaches (Orians, 1980, 1986; Orians & Heerwagen, 1995) maintain that humans have an innate preference for savanna-like settings that arises from their long evolutionary history on the savannas of East Africa (the widely presumed site of human origins). Orians proposed that for early humans, savanna-like settings were most likely to offer survival resources such as food, water and protection from danger. Orians listed savanna characteristics of presence of water, scattered trees with grasses and shrubs, open spaces, and distance views, all of which have been linked to evolutionary predispositions. In the present time urban environments, these characteristics are most often found in parks. Researchers have found that Americans prefer park-like settings with a ground cover of grass, which might be characterized as a savanna referred by anthropologists (Jackson, 1982; Schroeder and Green, 1985). Preferences for savanna-like settings were found cross-culturally, in studies of Europeans, Asians, and Africans as well (Korpela and Hartig, 1996; Purcell et al., 1994).

Balling and Falk's study (1982) found limited support for this approach. They examined landscape preferences of a broad spectrum of ages with third graders, sixth graders, college students, adults, senior citizens, and professional foresters for various kinds of environments. The strongest preference for savanna was found among elementary school children. From mid-adolescence and through adulthood, more familiar landscapes were equally preferred to savanna-like environments. Since none of the children who participated in their study had previously been exposed to the savanna landscape, the researchers interpreted that a preference for savanna is innate rather than learned. They confirmed that the results are consistent with such a model of continuing savanna preference.

The Kaplan and Kaplan's functional-evolutionary theory (Kaplan, 1975, 1987; Kaplan and Kaplan, 1995) maintains that humans are more likely to function effectively in those environments that possess attributes similar to the natural settings in which we evolved compared to non-natural worlds. Ulrich also asserts that the universal response of human to nature suggests that it is not a cultural or a learned one. The Ulrich's psycho-evolutionary theory (Ulrich, 1983, 1991) proposes that our behaviors, attitudes, cognitions, emotions, are shaped by what proved adaptive during human evolution.

The evolutionary perspectives espoused by Kaplan and Kaplan and by Ulrich overlap in that humans have a genetic propensity for being attracted to nature because of their evolutionary heritage and the demands of survival during their development. Human responses to natural environments are a means by which we are all evolutionally prepared for its benefits, even if we have never seen a landscape or other types of natural environments or never learned about such benefits from them. To experience the restorative values of nature requires no special preparation. Both theories are also common in that natural environments hold positive attention, may block negative thoughts, and produce stress-reducing effects (Kaplan, 1992b, 1992c; Ulrich, 1983).

There is, however, an important difference between the two approaches. Kaplans' functional-evolutionary perspective focuses on the cognitive assessment of environments preceding an emotional response to natural content (Kaplan, 1975, 1987, 1995; Kaplan and Kaplan, 1995), while Ulrich's psycho-evolutionary theory considers cognition to be of secondary importance. Ulrich's theory supports that our rapid responses to plants and other nature are evolutionary first with an affective or emotional basis and physiological response (Ulrich, 1983, 1991). These issues remain controversial.

Lewis (1995a, 1996) also attributes human beings' attraction to nature/plants back to the evolutionary process. According to Lewis (1980), as biological entities humans developed in natural environments far different from the created urban environments of today. Humans intuitively prefer natural settings, which are most familiar. However, urban or built environments cannot produce this familiarity because modern humans have not had enough time to prepare restorative responses to it. He believed contact with nature/plants, either passively (i.e., a window view) or actively (i.e., gardening), was important for humans to deal with their negative stress while living in a built environment (Lewis, 1979, 1980, 1996). Because nature has restorative qualities in its place and process, it can affect people positively such as by ameliorating urban harshness, improving their health and well-being, and refreshing their spirit. He strongly recommended bringing nature/plants to reduce stress in the city or any built environment, which are stress-inducing environments.

Attention Restoration Theory

Some psychologists have emphasized that exposure to nature/plants helps to maintain or restore one's directed attentional capacity (Kaplan, 1995; Kaplan and Kaplan, 1982, 1995). The attention restoration theory, proposed by S. Kaplan, builds on assumptions about the evolution of human cognitive capabilities in natural environments. It also builds on a distinction between directed attention and fascination.

The basic concept of the attention restoration theory was inspired by W. James, who has proposed two types of attention: voluntary attention and involuntary attention (James, 1892). In emphasizing the possible susceptibility of fatigue from the voluntary attention, Kaplan (1995) shifted to calling the term 'voluntary attention' for 'directed attention.'

According to Kaplan, directed attention is a voluntary reaction that requires an effort, therefore, it is likely to be subject to mental fatigue if directed attention used prolonged periods. Mental fatigue or directed attentional fatigue is characterized by having difficulty focusing on tasks, feeling irritable, and being distractible. Involuntary attention, on the other hand, requires no effort and blocks out mental fatigue. James (1892) and Kaplan (1995) pointed out that involuntary attention can be learned by experiences.

Kaplan has substituted the term 'fascination' for 'involuntary attention', which is one of the four critical properties of restoration (being away, extent, fascination, and compatibility) from a fatigued capacity to direct attention. Kaplan emphasized that nature is one of the most fascinating objects with easily and strongly holding the attention. Because the natural environments such as a garden are extremely interesting to the individual, thus drawing involuntary attention, and rest from directed attention (Kaplan, 1992b, 1992c). Csikszentmihalyi (1978) also pointed out that nature views might be quite successful in redirecting attention and blocking thoughts associated with “current concern” from largely negative and stressful places such as a hospital. These researchers believe nature/plants prove to be the most reliable source of restoration from mental fatigue.

HUMAN HEALTH AND WELL-BEING

Nature and Its Meaning

Nature holds deep meaning for most of us as a place of refuge, peace, and tranquility (Wohlwill, 1983). Nature soothes and heals tension and mental fatigue associated with city and modern life. F.L. Olmsted, an American famous landscape architect, once asserted a strong belief in restorative psychological effect of nature in cities.

> “Nature employs the mind without fatigue and yet exercises it; tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system (Olmsted, 1865).”

Experiencing natural environments contributes to psychological and emotional human well-being. Nature is able “to refresh and delight the eye and through the eye, the mind and spirit (Olmsted, cited in Beveridge and Rocheleau, 1998, p. 31).” His belief was reflected in his designs of many public parks and urban landscaping in America such as Central Park in New York City and continuously provides a special amenity of nature for millions of Americans.

Human feelings of comfort and solace in nature may result from the symbolism inherent in nature itself. Nature symbolizes life itself for representing birth, growth, and death (Wohlwill, 1983), and symbolizes continuity because nature is stable, predictable and universal (Scheffer, 1977; Stillman, 1975). Nature also seems to emerge as a symbol of mystery and spirituality playing a significant role in religion of diverse cultures (Kaplan and Talbot, 1983; Lowenthal and Prince, 1976).

Studies of Nature on Health and Well-being

An extensive body of studies has pointed to an important role of natural environments on stress reduction and restorative benefits (Catanzaro and Ekanem, 2004; Kaplan, 1995; Kaplan and Kaplan, 1995; Kaplan et al., 1988; Lewis, 1995a, 1996; Ulrich, 1979, 1983, 1986). Wise and Rosenberg (1988) examined the role of nature décor in alleviating stress symptoms in isolation and confinement of space environments. The findings suggested that interior décor depicting natural landscapes were aesthetically preferred and successfully reduced physiological stress created by mental work. Hartig et al. (1991) measured recovery effects of stressed individuals made by demanding cognitive task. After exposure to stress, subjects selected one of three conditions: reading magazines or listening to music, walking in an urban area, or walking in a nature area. Findings showed that individuals who had been walking in a nature area had more positive feelings than those in other conditions.

A Kaplan study (1993) showed that workers who are in a more natural environment have fewer headaches, less stress and more job satisfaction than those who are not. In the residential context, Talbot and Kaplan (1991) found that views of nature from windows are important to the elderly, especially flowers and outdoor sitting area, and having nearby nature contributed to residential satisfaction. Kaplan (2001) also found that views of nature from windows enhance residents' sense of well-being using a survey with both verbal and visual material.

More specifically, a number of studies have found that natural environments and urban environments with nature are preferred over places without living plants (Herzog et al., 1982; Kaplan, 1983; Talbot et al., 1987; Ulrich, 1984). Ulrich (1979) examined a stress reducing effect of natural scenes on students who were experiencing mild stress by a final exam. Findings suggested that the natural scenes held attention more effectively and fostered greater recovery as compared to urban scenes lacking nature, as indicated by reduced fear and enhanced psychological states. In subsequent research, Ulrich (1981) demonstrated that one dose not need to be stressed to experience emotional benefits of nature. Unstressed individuals were found to be significantly relaxed while viewing natural scenes, indicated by physiological measurements such as higher alpha brain wave amplitudes and lower heart rates.

In a related study, Ulrich and Simons (1986) have demonstrated that recovery from stress is faster when viewing scenes of nature, indicated by positive physiological changes such as lower blood pressure and reduced muscle tension. They noted that relaxation occurred within only three to six minutes when people viewed nature scenes. They suggested that even brief visual contacts with plants might be valuable in restoration from mild, daily stress. Another study by Ulrich et al. (1991) monitored physiological and psychological recovery from stress and suggested stress recovery effects of natural environments may have important health consequences. Honeyman (1992) expanded on these studies to include scenes with buildings and plants. She found that the settings containing prominent vegetation produced greater restoration than settings without vegetation in an urban environment with buildings. Parsons et al. (1998) investigated whether roadside environments influence a driver's stress recovery. They reported participants who viewed nature-dominated drives had a faster recovery to subsequent stress than participants who viewed artifact-dominated drives. Hartig et al. (1991) have reported similar physiological and psychological restoration effects attributable to interactions with natural environments, suggesting that exposures to natural environments may have an immunization effect for future stressors.

Tennessen and Cimprich (1995) found that university dormitory residents with natural views from windows had better performances on attentional measures, as compared to those with built views from windows. They suggested that exposure to the natural environment helps to restore one's directed attentional capacity. Herzog et al. (1997) conducted a study on students to determine the preferred settings for attention recovery and reflection. The students asked to rate the suitability of environments, ranging from urban, sports and natural, for recovering their abilities to concentrate after a demanding intellectual task (for attentional recovery), and for allowing them to resolve a serious personal problem (for reflection). This study also found that natural settings had higher scores for both attentional recovery and reflection as compared to urban and sport settings.

Kuo and Sullivan (2001a) examined the relationship between vegetation and crime for residents living in apartment buildings in an inner-city neighborhood. The findings demonstrated that there exist significant negative relationships between the density of vegetation (trees and grass) and the number of crimes per building; i.e., with more vegetation around a building, fewer property and violent crimes occur. Researchers suggested that preserving vegetation in cities may have an important role on prevention for future inner-city crime. Another study by Kuo and Sullivan (2001b) showed that residents living in apartment buildings with nearby vegetation in an inner-city neighborhood exhibited significantly less aggression against their partners than those living in apartments in barren surroundings. They also found that those with nearby trees were experiencing a restorative effect, while those in barren surroundings experienced a level of mental fatigue. These studies suggest that restorative effects of natural scenes attract human attention resulting in positive changes in emotional states.

Plant and Its Meaning

Plants are fundamental to all forms of life including human beings (Janick, 1992; Lewis, 1996; Mattson and Kiyota, 1999; Sullivan, 1980). Plants increase oxygen and remove carbon dioxide. Plants provide water purification, food, medicine, energy, materials for shelter, and fibers for clothing (Lewington, 2003).

Plants are given for all occasions and for many reasons. Basically they are given to convey thoughtfulness and love or to express emotional feelings which words are unable to convey (Doyle et al., 1994; Mattson, 1992; Pickles, 1990; Shoemaker et al., 1992). Plants and flowers are often associated with symbolic and metaphoric meaning (Cremone and Doherty, 1992; Mattson, 1992; Stamm and Barber, 1999; Todd, 1993; Zhou, 1995). Plants, especially flowering ones, represent life, growth and hope. Flowers brought to the sick as gifts are an indication of nature's powerful symbolic value. Flowering plants can also provide interest and diversion (Hughes and Bryden, 1983; McDuffie, 1984; Wasserman, 1974) and naturally induce positive thoughts and memories due to their unique colors, fragrance, and strong aesthetic components.

Not all people will find the same meaning in a given plant and flower (Cremone and Doherty, 1992; Doyle et al., 1994). Responses are highly personal because what is observed is not separable from the observer's experience (Lewis, 1995b). The meaning associated with a specific plant or flower differs between cultures as well. However, it is certainly true that plants and flowers are associated with many positive meanings.

Positive relationships with plants can make people feel that they are fully human beings (Lewington, 2003; Lewis, 1995a, 1995b, 1996; Matsuo, 1995; Menninger and Pratt, 1957; Relf, 1999; Venolia, 1988). As Venolia (1988) described it, "relationships with plants provide a powerful ongoing connection with life... plants can reconnect us with the earth and life's cycles (Venolia, 1988, p.130)." How is individuals' connection with life created by relationships with plants? It may be because plants and people share the rhythm of life. Both are alive and go through the same basic biological development of birth (germination), growth, maturation, reproduction, and death. Stamm and Barber (1999) at the Menninger Foundation in Topeka, Kansas further explained this phenomenon, based on their experiences working with psychiatric patients.

> "Horticulture provides a meaningful emotional experience because it deals with life and the life cycle. Although it deals with life cycle of plants, most people make a direct and ready translation between the life cycle of plants and their own human life cycle. Issues of germination and birth, of nurturance and caretaking, of unexpected reversal, traumas, and loss are just a few of the powerful existential dramas that can be played out in parallel fashion in the human and plant world (p.59)."

By observation of plant growth and change, individuals can learn about the life, receive messages concerning life qualities, and apply them to other aspects of life. Caring for or simply watching plants can refresh human minds, soothe their souls, and restore their sense of well-being.

Benefits of Indoor Plants

Since more than 80% of population live in urban areas (Louis Harris and Associates, 1978), away from natural scenery, and spend over 90% of their time indoors, both at work and at home (Abbritti and Muzi, 1995; American Lung Association, 2004), the use of indoor plants might be the only way people can be connected with nature and life's cycle. Therefore, when people bring plants into the indoors, it has an important meaning of bringing nature into the man-made environment and bringing life to them. These are not luxurious objects, but are essential for human existence (Lewis, 1979, 1986, 1996; Venolia, 1988). Venolia (1988) commented that plants "have an important role in the built environment, and they may be just what we need to overcome some of the isolating effects of buildings. Simply gazing upon a plant can lift the spirits and calm the mind (p.130)." Simply having plants around people can create an 'outside-inside' experience and give them a sense of connection to nature.

The association of people with indoor plants seems to be beneficial in many ways. Plants immediately improve the physical appearance of any indoor area (Dietz, 1970; Moore, 1989; Stevenson, 1970; Venolia, 1988). They can soften a harsh environment and provide a tranquil, beautiful, and therapeutic environment to people. Indoor plants not only make environment look good, they cleaned air people breathe. A growing body of research is offering that plants provide an optimum indoor environment by acting as natural filters (Wolverton, 1997; Wolverton and Wolverton, 1993; Wolverton et al., 1984, 1985, 1989, 1990).

More importantly, the human body and mind positively benefit from the presence of indoor plants (Bruce, 1999; Gesler, 2003; Lewis, 1996; Venolia, 1988). The increasing complexity of both technological work and the built environment is a source of many negative stress responses. What people experience from their surroundings affects their moods and emotions and the way in which they act. The nurturing plants can ameliorate this stress and provide maintenance for a healthy life (Lewis, 1972, 1986, 1995b, 1996). Interaction with indoor plants, both passive and active, can not only change people's emotions and feelings, but also their physiological responses, including brainwave, heart rate, blood pressure, and muscle tension. This is evidenced by many scientific studies examining the human health benefits of plants (Chang, 2000; Chang and Chen, 2005; Cho, 2002; Coleman and Mattson, 1995; Doxon et al., 1987; Kim and Mattson, 2002; Lohr and Pearson-Mims, 2000; Lohr et al., 1996; Liu et al., 2003, 2004; Owen, 1994; Park, 2002; Park et al., 2004; Ulrich, 1991; Ulrich and Simons, 1986; Ulrich et al., 1991; Yamane et al., 2004).

Plants are always changing slightly and are never static (Venolia, 1988). The growth of leaves, flowers' blooming, and the creating of seeds for next generation, those movements are stimulating and holding human attention, yet relaxing (Moore, 1989). Plants are also "non-threatening, offering their reward without discrimination as regards age, race, language, sex, or social status (Lewis, 1972, p. 280)." Plants are non-judgmental and do respond to care.

In addition, plants stimulate a greater variety of sight, touch, smell, taste, and hearing sensations (Brown, 2001; Bruce, 1999; Caplan, 2006; Haas and McCartney, 1996; Namazi and Haynes, 1994; Rawlings, 1998; Venolia, 1988). Indoor plants such as flowering indoor plants, ornamental plants, and herbs can provide beautiful colors and different patterns. The color of the blossoms attracts human attention, but so does the size and shape of the flower, the way the foliage compliments, accents or contrasts. Much of the delightful color of the indoor plants comes from the leaves as well. Visual appeal is not limited to color and pattern. When wind comes through a window, watching the dance of plants' leaves could be enjoyed. Other movements of plants such as the growth of a leaf, the opening of a flower, and the swelling of its fruit are also enjoyable.

Adding scented plants to the indoors could provide fragrance, stimulate human olfactory senses and make them feel good. Many plants also have scented leaves, roots, and even seeds. If those plants are placed on the windowsill and a breeze comes through the window, fragrance may fill indoor place and stimulate human olfactory sensation. Taste is inseparable from the sense of smell. The rest of the flavor comes from the aroma. Edible plants such as herbs and particular flowers may stimulate the taste sensation.

One of the fascinations of indoor plant growing, rather than just seeing pictures or looking at them from far away or through window, is that people can touch them. Plants provide various tactile experiences with distinctive or unique foliage, stem, flowers and fruit. By touching plants, individuals can be sensitive to the difference in texture between varieties, and the differences between young leaves and mature ones. Non-plant material is an important part of tactile stimulation as well. The small stones or pieces of bark in a plant container, and the texture of the container itself are a part of the indoor garden people can reach out and touch. If plants are displayed close to a window, one can hear the beauty of the breeze by touching lush leaves of the plants as well.

One of the great advantages of indoor plants might be the fact that these positive forces can be enjoyed year-round. Wherever sunlight or fluorescent plant-growing lights are available, plants can be grown inside (Daubert and Rothert, 1981; Kreidler, 2002). Atriums, greenhouses, planters, pots, and window boxes all allow constant enjoyment of green plants as well as blooms in the indoor environment. Winter days can become summer days with flourishing plants in a rainbow of colors, textures, and shapes growing where stimulation and a change of season is needed.

Studies of Plants on Health and Well-being

Multi-disciplinary researchers indicate that interaction with plants, both passive and active, can change people's emotions, attitudes, behaviors, perceptions of space, and physiological responses. Langer and Rodin (1976) found beneficial effects of residents in a nursing home who cared for plants to enhance sense of control. Residents given charge of the plants showed better health and activity pattern, enhanced mood and sociability, and increased well-being compared to the residents who were given plants and told the nurses would care for the plants. An eighteen-month follow-up study confirmed theses beneficial effects of a control-relevant intervention (Rodin and Langer, 1977). Laviana et al. (1983) examined whether plants influence an individual's feelings toward and evaluation of the indoor environment. The results showed that presence of plants significantly improved individuals' perceived quality of the indoor space, however, did not affect thermal responses. Kweon et al. (1998) found that green common spaces, including trees, plants, and lawns, were correlated with stronger social integration of low-income urban elderly. This strong social integration created by green spaces is also associated with positive health benefits.

Perrins-Margalis et al. (2000) reported that indoor plant activities have an immediate and positive effect on life satisfaction, well-being, and self-concept among people with chronic mental illness, evidenced by higher ratings of the Quality of Life (QOL) questionnaire. More recently, Barnicle and Midden (2003) reported that working with plants is effective to improve psychological well-being of the elderly living in a long-term care facility demonstrated by higher scores of the Affect Balance Scale (ABS). Robinson and Zajicek (2005) found that elementary school children who were working with plants did significantly increase life skills including teamwork, self-understanding, leadership, decision-making skills, communication skills, and volunteerism. Waliczek et al. (2005) reported that people who are regularly working with plants rated higher scores on the Life Satisfaction Inventory A (LSIA) relating to energy levels, optimism, zest for life, and physical self-concept, further rated better scores on their overall health and physical activity levels, as compared to people who are not working with plants.

Bennett and Swasey (1996) surveyed urban residents to identify why they visit public gardens. They found that stress reduction, relaxation and inspiration are most important reasons for visiting the gardens. Other survey studies by Dunnett and Qasim (2000), Hamilton and DeMarrais (2001), and Kohlleppel et al. (2002) also documented that botanic garden visits reduce perceptions of stress and improve feelings of well-being. These researches confirmed that urban residents visit public gardens as means of effective coping strategies against urban stress. More recently, Rappe and Kivelä (2005) found garden visits improve mood, quality of sleep, and ability to concentrate among elderly people living in a nursing home.

Studies have reported physiological evidences of the stress reducing benefits of plant environment. Doxon et al. (1987) reported that developmentally disabled adults had lower stress while working in a greenhouse than in a training center, as indicated by lower electrodermal responses and blood pressure, and higher finger skin temperatures. This study pointed out that vocational training of mentally challenged adults in a greenhouse environment could improve health and productivity of workers by reducing stress. Owen (1994) examined the influence of a botanic garden experience on human stress reduction. This study found that systolic and diastolic blood pressures of participants were decreased significantly after walking through flower-filled landscapes of a botanic garden and concluded that a botanic garden experience significantly reduced visitors' stress. Rodiek (2002) also reported stress-reducing experiences of an outdoor garden in elderly populations demonstrated by lower level of salivary cortisol. Coleman and Mattson (1995) conducted thermal biofeedback sessions with university students. They found a positive influence of foliage plants on human stress reduction during thermal biofeedback training, as indicated by higher skin temperatures. Lohr et al. (1996) showed stress-reducing effects of indoor foliage plants when they were placed in a windowless computer work place demonstrated by lower systolic blood pressures, as compared to no plants present in the same work place.

Research findings support that plant environments have an important value in stress recovery as well. Lee and Sim (1999a) examined the effects of indoor plants on recovery from psychological stress by measuring galvanic skin resistance (GSR) and suggested viewing plants have a beneficial effect on stress recovery evidenced by greater recovery in GSR response. Kim and Mattson (2002) examined the stress recovery effects of viewing red-flowering plants as compared to non-flowering plants and to no plants, by measuring psychophysiological indicators and self-rated emotional states. They reported that viewing red-flowering plants enhanced stress recovery of high-stress induced female college students, as indicated by greater recovery in electroencephalograph (EEG) beta activities and electrodermal activity (EDA) responses. Females who viewed red-flowering plants also showed self-reported improved positive emotions and greater attentiveness in the Zuckerman Inventory of Personal Reactions (ZIPERS).

Research on immune systems also defines the dimensions of plant and flower stimuli as healing media. Cho (2002) investigated how plant interactions affect the selected measurements of adrenal-immune function in female university students. The measurements were the concentration of salivary cortisol and secretory immunoglobulin A (sIgA), affective response, and symptoms related with upper respiratory infections between a horticultural laboratory class and a horticultural lecture class. The horticultural laboratory group had increased positive emotions, a slightly lower level of cortisol, and higher sIgA concentrations, as compared to the horticultural lecture group. The results of this study suggested that longer-term experience of plant interactions may positively affect stress hormones and sIgA, as well as improve student affective responses.

Other evidence suggesting therapeutic values of plant environments has come from research in work places where plants are simply viewed. Studies indicated that adding indoor plants to office environment are resulted in improving work productivity (Lohr et al., 1996) and job satisfaction (Kaplan, 1992a; Kaplan et al., 1988), enhancing perceived attitudes projected in environment (Aitken and Palmer, 1989; Larsen et al., 1998; Shoemaker et al., 1992), increasing satisfaction with indoor space (Biner et al., 1993; Jankowski, 1980; Laviana et al., 1983; Mateja, 1988; Randall et al., 1992), and reducing anxiety and stress from work (Lohr et al., 1996; Tomono, 2003).

Laviana et al. (1983) reported indoor plants in a simulated office had a positive influence on human affectivity. Fjeld et al. (1998) documented that when the indoor plants were presented in the office workplace, health-related symptoms, such as coughing and itchy skin, were reduced. Another study by Fjeld (2000) also reported similar findings of indoor plants in the workplace on health benefits. Lohr and Pearson-Mims (2000) demonstrated that subjects in an office room with foliage plants were able to tolerate the physical stress longer than subjects in the room without those plants. More recently, Chang and Chen (2005) examined the effects of indoor plants and window views with nature on human psychophysiological responses in work environments, measured by electromyography (EMG), electroencephalography (EEG), blood volume pulse (BVP) and state anxiety. This study found that participants were less nervous or anxious when watching a view of nature and/or indoor plants.

A number of studies have found that flowers are able to change human behavior, emotion, cognition, and physiology. Laviana (1985) assessed college students' attitudes concerning the impact of plants in a simulated office environment. The results demonstrated that plants improved persons' perception of the environment and regardless of high or moderate density of plants, an office with plants was more acceptable than one without plants. Especially flowering plants have positive impact on individuals' perception of odor quality and strong association with initial excitement responses. Adachi et al. (2000) examined the effects of floral and foliage displays on human emotions and found that a floral display changed human emotions more positively, as compared to a foliage display. Chang (2000) explored the correlation between flower color, respondents' electromyography (EMG) values and anxiety states. The red flower resulted in the lowest EMG values and the pink flower resulted in the lowest anxiety states. Liu et al. (2003, 2004) investigated visual and olfactory effects of flowers and floral fragrance on human responses. He reported that cut flower arrangement and lavender fragrance had less physiological arousal, enhanced emotional states, and improved cognitive performance. These studies support the conclusion that flowering plants have beneficial influences on people for increasing positive responses in behavior, emotion, cognition, and physiology.

Polluted indoor air has been associated with health problems such as asthma, sick building syndrome, multiple chemical sensitivity, and hypersensitivity pneumonitis (Abbritti and Muzi, 1995; Anderson and Anderson, 1999; Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society, 1996a, 1996b; Jalonen, 2004; Kilburn, 2000;

Myers and Maynard, 2005; Nakazawa et al., 2005; Oliver and Shackleton, 1998; Zhang and Smith, 2003). Symptoms are often nonspecific and include headache, dryness and irritation to the eyes, skin and throat, chest tightness, shortness of breath, and fatigue. People in a hospital environment often complain about these problems (Quinn et al., 2006; Smedbold et al., 2002; Wilburn, 1999).

There is now significant evidence from a range of studies that indoor plants provide an optimum indoor environment by acting as natural filters. Studies conducted in the National Aeronautics and Space Administration (NASA) have demonstrated that common houseplants have the potential for improving indoor air quality and reducing sick-building syndrome by removing pollutants, including formaldehyde, benzene, carbon monoxide and nitrogen dioxide, from the contaminated air (Wolverton, 1997; Wolverton et al., 1984, 1985, 1989, 1990). Raza et al., (1991) reported some succulent plants remove CO_2 from indoor air during the night, thereby improving indoor air quality. Other researchers also investigated the response of indoor plants to pollutants and reported that plants significantly reduce indoor air pollution and provide improvement of air quality (Darlington et al., 2001; Giese et al., 1994; Lee and Sim, 1999b; Mansfield, 1976; Nishida et al., 1991; Ross et al., 1997; Schulte-Hostede et al., 1987; Tingey and Andersen, 1991; Treshow, 1984; Wood and Burchett, 1995; Wood et al., 1999, 2002).

Lohr (1992) investigated the impact of indoor plants on relative humidity in an office with a central, forced air system. She found that plants significantly increased relative humidity to the surrounding air, which increased the comfort level for humans. In contrast, relative humidity in an office without plants was slightly below the range recommended for human comfort.

Others explored the impacts of indoor plants on dust accumulation in interiors. Lohr and Pearson-Mims (1996a, 1996b) have shown that adding foliage plants around the periphery of a room reduced dust accumulation on horizontal surfaces in indoors by as much as 20%. Another study conducted by Wolverton and Wolverton (1993) also reported that the presence of indoor plants and their potting media did not make air dustier, in fact, they significantly reduced the quantity of interior mold spores and airborne microorganisms.

The potential risk of infection arising from fresh flowers or potted plants relates to organisms in the water, medium in the container, and the plant itself has been commonly believed among medical personnel. Therefore, patients were not allowed to receive the traditional gift of plants and flowers from their visitors or to participate in horticulture-related activities during the hospitalization. However, there are no scientific evidences that flowers, potted plants, water in flower vases, or medium in the plant container have spread disease in hospitals and have been considered at risk, except to severely immunocompromised and intensive care unit patients such as oncology patients and transplant recipients (Bacterial Diseases Division of the Center for Disease Control, 1978; Bisset, 2003; Centers for Disease Control and Prevention, 2003; Chambers, 2003; Gale et al., 1977; Gould et al., 2004; Hoeprich et al., 1994; Humphreys, 2006; Poe et al., 1994; Schroth et al., 1973; Wenzel et al., 1998).

According to the Centers for Disease Control and Prevention (2003),

> “Despite the diversity and large numbers of bacteria associated with flower-vase water and potted plants, minimal or no evidence to indicates that the presence of plants in immunocompetent patient-care areas poses an increased risk of health-care-associated infection (p.80).”

Bartzokas et al. (1975) demonstrated that while large numbers of pathogens may be cultured from the water in flower vases, they were not the same strains as the bacteria responsible for causing infection among nearby patients. Siegman-Igra et al. (1986) drew similar conclusion with potted plants. They selected three to seven potted plants randomly from six surgical wards (general, vascular, urologic, orthopedic, neurosurgical, and thoracic) and obtained 79 isolates of Gram-negative bacteria from 29 plants. The finding revealed, however, there was no relationship between the organisms isolated in the soil of the plants and the 235 isolates obtained from nearby patients throughout the study period. All the plants were positioned in areas of major activity including patient dining table, nursing station and medication preparation alcove. Another study by Wenzel et al. (1998) identified infection risks associated with flowers and plants and suggested that in general hospital wards, except the immediate environments of severely immunocompromised and intensive care units patients, infection risks could be avoided by sensible infection control precautions, such as hand hygiene using disinfectants and wearing gloves. The addition of 1% hypochlorite to the water in flower vases was recommended as a further infection control precaution. There was no suggestion that flowers and plants should be banished from general wards.

Some researchers reported that flowers in hospitals were not significantly more contaminated with bacteria compared with flowers in restaurants or in the home (private garden) (Kates et al., 1991). No differences in the diversity and degree of antibiotic resistance of bacteria have also been observed in samples isolated from hospital flowers compared to those obtained from flowers in restaurant and in the home.

The studies documenting indoor plants are significantly associated with improvement of air quality in interiors, human health and wellness have also disapproved the common beliefs that patient's room should not contain any flowers and potted plants because the plants and their growing medium in containers might be making interiors unhealthier and dustier. Medical personnel who restrict their patients hospitalized in general wards from plants and plants-related activities during their hospitalization may be depriving many therapeutic benefits of plants offered to patients.

Studies on Health Benefits of Nature/Plants within a Healthcare Setting

A considerable body of published research indicates that natural environments in a healthcare setting have beneficial influences on human health and wellness. Ulrich (1984) examined patients recovering from gall bladder surgery to evaluate whether those in a hospital room with a window view of a natural setting might have therapeutic influences. The findings of this study suggested that patients with a window view of nature had shorter post-operative hospital stays, had fewer negative comments in nurses' notes, and tend to use fewer potent pain-reducing drugs than did patients with a window view of a brick wall. Verderber (1986) measured responses of hospital staff and patients with severe disabilities using a photo-questionnaire and found a high preference for window views including natural scenes of trees. This study suggested that a view of nature through the windows is vital to the people who undergo illness, giving them a sense of connection to outside nature, which contributes to their healing process. Coss (1993) reported that patients lying down on stretchers in a presurgery holding room who were exposed to ceiling pictures of nature scenes had substantially lower blood pressure (10 to 15 points) than patients looking at blank ceilings or other aesthetically pleasing outdoor scenes. Cooper Marcus and Barnes (1995) and Nelson and Paluck (1980) reported that Alzheimer's disease patients with dementia seemed to show some functional improvement when their environment included vegetation and gardens.

In a pilot study by Heerwagen and Orians on patient anxiety in a dental clinic (Heerwagen, 1990), data of heart rate measurements and affective self-ratings suggested that patients felt less stressed on days when a large mural depicting a spatially open natural landscape was hung on a wall of the waiting room, in contrast to days when the wall was blank. Ulrich et al. (1993) investigated whether exposure to visual stimulation in hospital intensive care units, including simulated natural views, promotes wellness with respect to the postoperative courses of open-heart surgery patients. Results suggested that patients exposed to the natural view experienced significantly less postoperative anxiety, had better overall recovery, and required fewer doses of pain medication, while patients with abstract painting responded negatively, even asked for it to be removed. A more recent study at Johns Hopkins University reported using nature scene murals and sounds as an intervention in a randomized control design significantly reduces pain in patients undergoing flexible bronchoscopy (Diette et al., 2003).

In a study of health care utilization in prisons, Moore (1981-2) found that inmates with natural views from their window had lower rates of sick call and fewer visits to the infirmary than did inmates lacking natural views from their windows. West's (1986) study supported these findings in another prison environment.

Individuals suffering pain in the hospital environments need a strong capacity to direct attention in order to deal with diagnosis and treatment as well as the illness (Eccleston and Crombez, 1999). Because directed attention requires mental effort, prolonged or intense demands on attentional capacity can lead to attentional fatigue (Kaplan and Kaplan, 1982; Posner, 1990; Posner and Snyder, 1975). Clinical reports show that many patients with pain are susceptible to loss of capacity to direct attention associated with attentional fatigue (Aistars, 1987; Irvine et al., 1991). Therefore, restoring attentional capacity would give critical therapeutic value to patients. In a study of post-surgery breast cancer patients, Cimprich (1993) reported that patients with nature-related activities such as walking in nature or gardening showed a significant improvement in attentional capacity and function, in contrast to patients in the nonintervention control group. This study showed that when patients have the capacity to direct attention to external environmental stimuli, competing stimuli must be actively blocked or inhibited.

Relatively few studies have focused on the role of indoor plants in fostering human health benefits within the hospital settings. Rae and Stieber (1976) found that while working with plants in a part of a play therapy program for children in a hospital, their psychological trauma of hospitalization is significantly reduced, and children felt more positively about the hospital experience. Stiles (1995) studied hospital patients seated in a waiting room during two different environmental conditions: the presence of indoor plants and the absence of plants. Questionnaire and observation data showed when the waiting area contained plants, patients rated the room as more restorative and pleasant. Also, patients voluntarily changed their seating position where they could look at plants. Park (2002) conducted bio-monitoring experimental sessions to examine pain tolerance and recovery effects of indoor plants in a simulated hospital patient room. She reported that viewing plants in a hospital setting significantly improved pain tolerance and enhanced recovery accompanied with promoting positive emotions. More specifically, findings indicated that ‘foliage plus flowering plants’ have more beneficial effects on pain tolerance and recovery as compared to ‘foliage plants only’ and ‘no plants’, as indicated by higher pain tolerance time, lower ratings of pain intensity and pain distress, and more positive psychological states. This study suggested that plant environments could be a therapeutic value to patients as one of the alternative strategies for pain management.

Additional evidence that indoor plants have important value on people in a hospital comes from psychiatric settings. Talbott et al. (1976), Farmer (1977), and Murphy (1977) examined the effects of flowering plants on the behavior of hospitalized psychiatric patients. The introduction of flowering plants in the dining room induced significant increases in talking, time spent in the dining room, and amount of food consumed. Another study by Rice et al. (1980) also determined that adding flowers and candles to the table helped encourage relaxation and socialization for psychiatric patients. Chung and Sim (1998) reported that introducing indoor plants in psychiatric hospital improved social behaviors and psychological disorders of schizophrenia patients. Smith (1998) demonstrated that horticultural (plants) activities in psychiatric units at a hospital are beneficial not only persons with chronic mental illnesses to improve social skills and self-esteem, but also nursing students and mental health unit staff to build positive relationship with their clients. Rappe and Lindén (2004) surveyed nursing personnel regarding the role of plants in homes for people with dementia. They confirmed medical professionals in the field of elderly care believe that plants stimulate their patients' senses and contribute significantly to the physical and psychological well-being of the individuals with dementia.

These studies documenting benefits of plants and other nature on patients in a hospital setting demonstrated that viewing actual nature/plants or pictures of nature/plants could have a positive influence linking directly to health and wellness. Moreover, it showed that the availability of nature/plants blocks stress and increases positive thoughts, regardless of whether patients are 'passive' or 'active' users.

However, clinical trials involving plants within a hospital setting concerning the therapeutic influences of indoor plants on health outcomes of patients recovering from surgery do not exist. If properly maintained, indoor plants can provide a great opportunity for surgical patients to experience nature in all seasons when outdoor scenery could not provide this benefit. Furthermore, indoor plants in patient room can provide meaningful therapeutic contact for, especially, those who spend much of their time indoors while recovering from painful surgery.

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CHAPTER 1 - THERAPEUTIC INFLUENCES OF PLANTS IN HOSPITAL ROOMS ON SURGICAL RECOVERY[1]

[1]For submission to Science

Abstract

This study investigated patients recovering from thyroidectomy surgery in hospital rooms with or without plants. Eighty female patients were randomly assigned to either control or plant rooms. Patients exposed to plants during recovery in hospital rooms had shorter hospitalizations, fewer intakes of analgesics, lower ratings of pain, anxiety and fatigue, and more positive feelings and higher satisfaction about their rooms than patients in similar rooms without plants. This study confirmed the therapeutic value of plants in the hospital environment as a noninvasive, inexpensive, and effective intervention for surgical patients in a general hospital ward.

Manuscript Text

By reducing stress, pain and anxiety experienced by surgical patients, speed of recovery may be increased (1-3). A view of a garden from a hospital room enhances involuntary attention, increases positive feelings, reduces worrisome thoughts, and promotes restoration from stress (4). Nature and plant experiences are positively associated with human physical (5-7), psychological (8-10), emotional (11,12), and cognitive health (13-15). In addition, viewing plants is linked to pain reduction, less need for analgesics, and faster recovery from surgery (16-19). This investigation determined if exposing surgical patients to plants has positive influences on stress reduction and fast recovery from surgery using multi-modal physiological and psychological measurements.

The sample consisted exclusively of patients who had undergone thyroidectomy surgery, which is a comparatively standardized medical procedure with similar postoperative management in the uncomplicated cases. The subjects consisted of eighty females who had a mean age of 36.2 ± 10 years. This trial was conducted from July 2005 to January 2006 at an 809-bed suburban university-affiliated hospital in Korea. This study was approved by the institution review boards of both the academic and hospital setting concerning human research protocols. Patients were informed that their medical history and current medical records would be reviewed and each signed an informed consent form (Appendix A). Patients were randomly assigned to either control or plant rooms (Fig. 1.1) located on the same floor as they became available (Appendix A). Hospital rooms used in the study included single and six-patient rooms. Equal numbers of hospital rooms were used that were identical except for the presence or absence of plants. Patients in the plant group were exposed to plants during their recovery periods following surgery until discharge. Excluded from the study were patients who were younger than 19 years or older than 60, and those who reported chronic (e.g., diabetes, high blood pressure) or current acute (e.g., upper respiratory infection) health problem, a history of psychiatric problems (e.g., depression, anxiety), or uncorrected hearing or visual impairments.

Data collected included the length of hospitalization, analgesics used for postoperative pain control, vital signs (blood pressure, temperature, heart rate, and respiratory rate), ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ). Patients were hospitalized a day before surgery in order to be given preparatory information about surgical procedures. On the day of admission, after obtaining the informed consent agreement and after health screening, patients completed the PPAF, STAI-Y1, and EAS in the hospital room. Twelve potted foliage and flowering plants with sterile, soilless potting mix were placed in the hospital room after patients left the room for surgery. Plants used for the study were *Dendrobium phalaenopsis* (Orchid), *Spathiphyllum* 'Starlight' (Peace Lily), *Epipremnum aureum* (Golden Pothos), *Howea forsteriana* (Kentia palm), *Syngonium podophyllum* 'Albolineatum' (Arrowhead Vine), *Pteris cretica* 'Albolineata'(Cretan Brake Fern), *Vinca minor* 'Illumination'(Vinca), and *Trachelospermum asiaticum* 'Ougonnishiki'(Yellow star jasmine). Each plant treatment room had similar types of plants, while no plants were allowed in the control rooms. Plants were grown in self-watering containers allowing patient viewing, but not direct intervention. During the recovery period, measurements of PPAF and STAI-Y1 were administered every other day (e.g., first, third, and fifth days after surgery). The second trial of EAS and the initial trial of PRSQ were administered at the last day of hospitalization. Space was provided on the PRSQ so that patients could add comments. All measurements were taken by the researcher except demographics, analgesic intakes and vital signs, which were recorded by medical staff.

Analysis of covariance (ANCOVA) (20) using SAS PROC GLM (21) was used for all data analyses except for analgesic data to test for differences between groups. Age was used as the covariate in ANCOVA to evaluate whether the age on the patients' responses are effective. The exact chi-square test (22) using SAS PROC FREQ (21) was used to compare the groups for analgesic intakes. The strength of analgesic categories used for postoperative pain control was computed for differences between groups for the day of surgery and first day after surgery, days 2 through 3 after surgery, and days 4 through 5 after surgery. Alpha level was set at 0.05.

Outcome data of length of hospitalization, analgesic intakes and vital signs were extracted from patient charts. Length of hospitalization was defined as days from surgery to discharge. These records provide evidence that patients who viewed plants had significantly shorter hospitalizations (6.08 days compared to 6.39 days) than those patients without plants (p=0.034). Postoperative analgesics were classified as weak, moderate, or strong on the basis of the drug, amount, and whether the medication was administered orally or by injection. The weak category was dominated by small doses of talniflumate, a nonsteroidal anti-inflammatory drug (NSAID), and the moderate category included large doses of talniflumate. In the strong category, injections of ketorolac tromethamine (NSAID) or combinations with talniflumate doses were used. In days 4 through 5 after surgery, analgesic intakes (Fig. 1.2) were significantly different for the plant group as compared to the control group (p=0.04). Patients exposed to plants received fewer weak and moderate analgesics than did patients in the control group. Vital signs were defined as the average of three readings taken per day. All measurements were taken using standard, noninvasive technology and recorded on patient charts. No differences were evidenced between the groups for vital signs during hospitalizations (Appendix B).

Levels of PPAF were measured using a 101-point numerical rating scale (NRS-101) (Appendix A). The validity of the NRS-101 and its sensitivity to treatment effects has been well documented (23, 24). Viewing plants made a statistically significant impact on differences in PPAF (Table 1.1). Self-rated pain intensity was significantly lower for those patients exposed to plants as compared to no plants at the third and fifth days after surgery (p=0.043, p=0.04, respectively). Patients in the plant group also had significantly less ratings of pain distress on the fifth day after surgery compared to patients in the control group (p=0.02). The dynamic changes of pain distress were parallel with that of pain intensity and consistently lower than the pain intensity ratings. Comparing the plant group patients to the control group patients, self-rated anxiety was significantly lower at the first and third days after surgery (p=0.047, p=0.04, respectively). At the fifth day after surgery, self-rated fatigue was significantly lower for patients in the plant group as compared to the control group (p=0.04). The STAI-Y1 (25) is comprised of a self-report measurement of anxiety and has been used extensively in research and clinical practice (Appendix A). Statistically significant differences emerged between the two groups (Table 1.1). Patients in the plant group were characterized by significantly lower levels of state anxiety than patients in the control group at the third day after surgery (p=0.03). This result was consistent with that of anxiety NRS-101 ratings.

To measure patients' feelings in response to their hospital room, the modified EAS (26) was used (Appendix A). The EAS consists of 13 adjective pair semantic differential scales. Significant differences between EAS responses of two groups were found for the eight items (Table 1.2). EAS responses to plants indicated that patients through the recovery periods felt their rooms more satisfying, relaxing, comfortable, colorful, happy, pleasant smell, calming and attractive, as compared to those in the control group. To assess patient satisfaction with the hospital room, patients were asked to complete PRSQ, which indicates three positive and three negative qualities of their room (Appendix A). While the majority of patients in the plant group indicated that plants were the most positive qualities of their rooms (95%), patients in the control group favored television (85%). The next categories of positive qualities regarding the hospital room included large windows (57%), sunshine (48%) and appropriate temperature (37%) for the plant group; and appropriate temperature (55%) and large windows (40%) for the control group. Regarding negative qualities of hospital room, patients in the control and plant rooms had similar negative comments concerning toilet facilities, insufficient space, and the hospital environment. Patients were further asked about their willingness to return to their hospital room in any future hospitalization. Ninety-three % of patients in the plant group responded positively, while 70% of patients in the control group reported a willingness to return.

Voluntary comments of plant group patients were collected from nurses, the researcher, and self-writings from PRSQ (Appendix B). Many patients stated that plants helped them relax or feel less anxious, and some believed that plants had diminished their pain. The presence of plants in the hospital room also contributed to building a positive patient image of the hospital, suggesting that medical staff were sensitive to the healing potential of "nearby nature" in the hospital environment. As patients recovered from surgery and regained mobility, nursing and medical staff reported increased interaction with plants. This included watering plants, removing dead leaves, touching them, and moving them for better view or close to window for better sunlight.

Results indicate those patients exposed to plants had significantly shorter hospitalizations, less need for analgesics, lower ratings of pain, anxiety and fatigue, and more positive feelings and higher satisfaction about their hospital rooms, as compared to patients without plants. Results are based only on female thyroidectomy patient responses. This study extends earlier research, which showed male and female patients with a natural (trees) window view had shorter hospital stays, fewer negative comments in nurses' notes, and fewer intakes of analgesics than did patients with a window view of a brick wall (19).

In most hospitals, patients were not allowed to receive traditional gifts of plants and flowers from the visitors. The potential risk of infection arising from fresh flowers or potted plants relates to organisms in the water, soil in the container, and the plant itself has been commonly believed, however, this was based on anecdotal evidence only. Flowers, foliage plants, water in flower vases, or soil in the plant container do not spread disease in hospitals or create a risk to patients, except with severely immunocompromised and intensive care unit patients (27-31). Further, practical solutions exist to reduce infection and the other risks attached to plants by sensible infection control precautions, such as hygienic hand washing and wearing gloves (31).

Interior space, such as that within a hospital, can be made healthier with the presence of living plants. Previous research indicates that indoor plants reduce sick-building syndrome by removing pollutants (32-37), increasing relative humidity up to human comfort level (38, 39), and improving indoor air quality by reducing the quantity of mold spores and air borne microorganisms (39).

Colorful fresh flowers and blooming or green plants, if properly maintained, allow patients to experience nature indoors when outdoor scenery could not provide this benefit. Further, indoor plants and flowers provide meaningful therapeutic contact for patients recovering from painful surgery. Findings of this study may not be applied to the immediate environments of severely immunocompromised and intensive care unit patients. However, the evidence is sufficient to support a recommendation that there is no reason to prohibit plants and flowers from a general hospital ward. This nonpharmacological and noninvasive approach is medically beneficial and clearly cost-effective to not only patients, but also hospital administrators and health insurance companies by reducing costs of hospitalizations, analgesic consumptions, and health insurance. Outcomes of this research may have influence on administrators' decisions concerning which treatment and therapeutic condition will be made available to patients.

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Figures and Tables

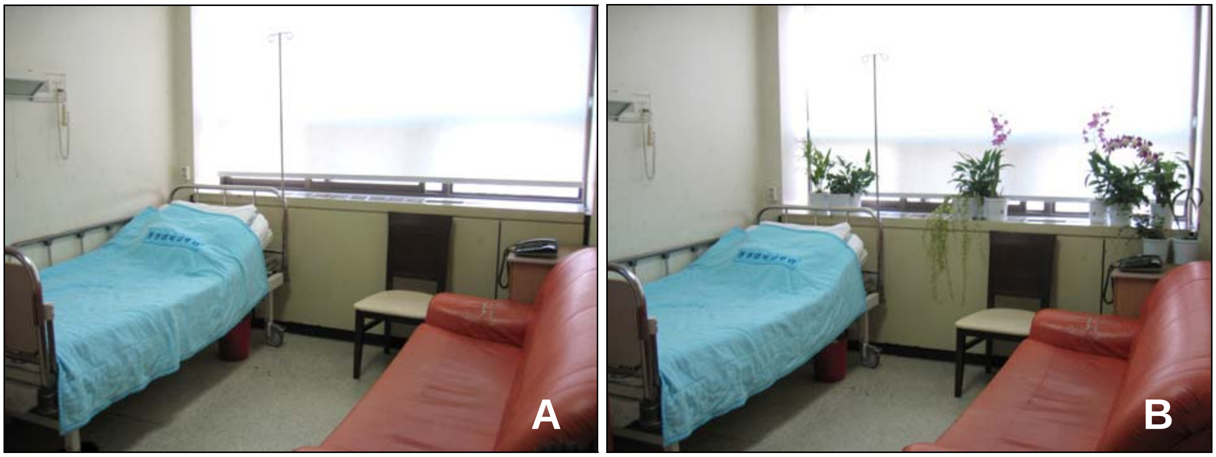

Fig. 1.1. Photographs of the two treatments: (A) no plants and (B) foliage and flowering plants.

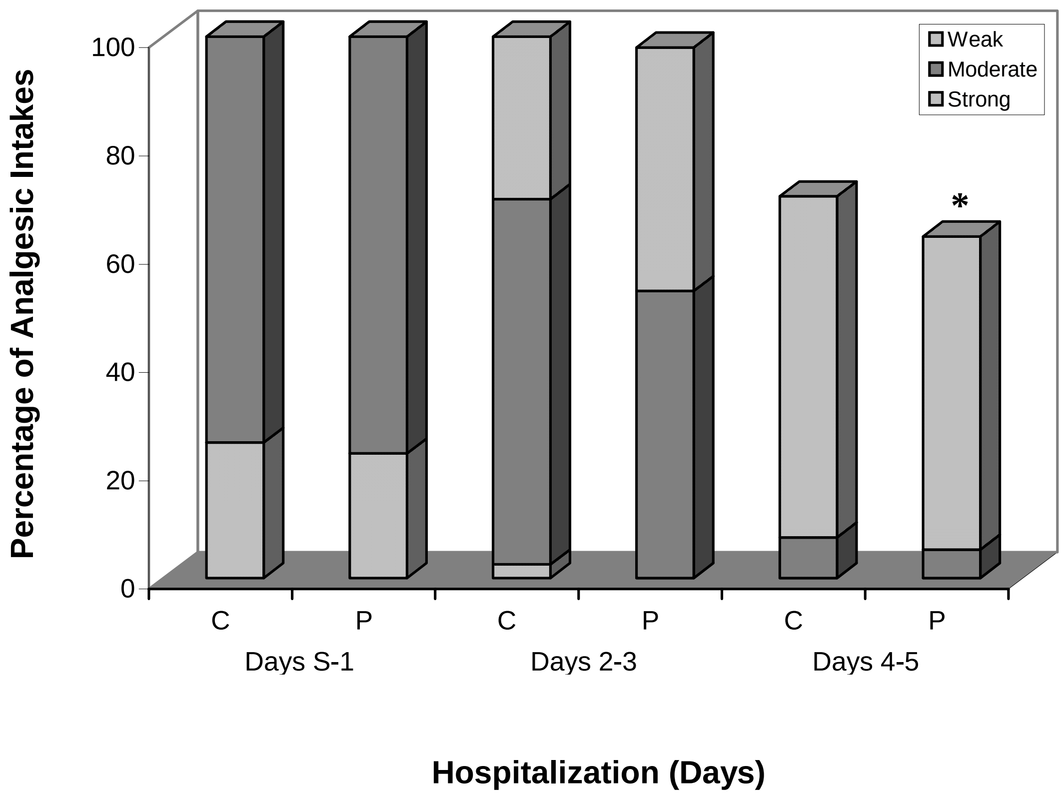

Fig. 1.2. Comparisons of control (C) and plant (P) groups in postoperative analgesic intakes. Days S-1, Days 2-3, and Days 4-5 indicate the day of surgery and first day after surgery, days 2 through 3 after surgery, and days 4 through 5 after surgery, respectively. * $P < 0.05$ (compared with control).

Table 1.1. Mean and standard deviation (SD) of control (C) and plant (P) groups in the rated for pain intensity, pain distress, anxiety, fatigue, and STAI-Y1.

	Pain Intensity[z]		Pain Distress[z]		Anxiety[z]		Fatigue[z]		STAI-Y1[y]	
	C	P	C	P	C	P	C	P	C	P
BS	3.77 (7.58)	6.89 (12.40)	2.74 (5.16)	6.14 (11.28)	66.05 (14.99)	67.16 (14.48)	43.35 (18.84)	40.77 (20.90)	47.14 (5.36)	49.41 (6.81)
D1	90.47 (10.10)	89.30 (9.77)	90.20 (9.28)	88.32 (9.95)	56.85 (10.69)	52.04* (11.71)	85.26 (8.36)	83.88 (10.16)	43.92 (5.51)	42.49 (5.59)
D3	74.29 (12.81)	68.24* (15.08)	69.37 (11.09)	65.54 (12.22)	28.55 (7.60)	25.17* (8.62)	49.34 (16.34)	42.27 (17.42)	36.33 (5.13)	33.90* (5.05)
D5	49.96 (15.66)	42.99* (13.87)	41.50 (10.99)	36.05* (12.01)	10.36 (6.86)	8.01 (6.07)	27.97 (12.61)	21.46* (12.49)	27.92 (4.22)	26.28 (3.66)

BS = before surgery; D1 = first day after surgery; D3 = third day after surgery; D5 = fifth day after surgery.

[z]Pain intensity: 0 = no pain, 100 = pain as bad as it could be; Pain distress: 0 = comfortable, 100 = excruciating; Anxiety: 0 = complete relaxation, 100 = the worst feelings of anxiety; Fatigue: 0 = no fatigue, 100 = worst fatigue.

[y]Twenty items (ten anxiety-present items and ten anxiety-absent items) were given a weighted score of 1 to 4 (1 = not at all, 2 = somewhat, 3 = moderately, 4 = very much). A rating of 4 indicates the presence of a high level of anxiety for ten anxiety-present items and the anxiety-absent items for which the scoring weights are reversed. Scores are ranging from 20 to 80. A lower value indicates less anxiety.

* $P < 0.05$ (compared with control).

Table 1.2. Mean changes in the 13 items of the Environmental Assessment Scale (EAS)[z] self-rated by patients with thyroidectomy (40 patients per group) before surgery and at the last day of hospitalization, in responses to viewing 'foliage and flowering plants' and 'no plants' during recovery.

Items	Control Group			Plant Group		
	Pre	Post	Post-Pre[y]	Pre	Post	Post-Pre[y]
Satisfying-Annoying	5.02	5.03	0.01	5.48	6.16	0.68*
Clean-Dirty	4.94	4.83	-0.11	4.98	5.12	0.14
Relaxing-Stressing	4.97	4.91	-0.06	5.17	5.84	0.67**
Comfortable-Uncomfortable	5.13	5.09	-0.04	5.19	5.61	0.42*
Colorful-Drab	4.26	4.18	-0.08	4.32	6.46	2.14**
Happy-Sad	4.56	4.45	-0.11	4.98	5.42	0.44*
Pleasant smell-Unpleasant smell	4.52	4.45	-0.07	4.58	5.08	0.50*
Bright-Dull	6.81	6.87	0.06	6.94	6.97	0.03
Spacious-Crowded	5.40	5.24	-0.16	5.42	5.14	-0.28
Calming-Irritating	6.32	6.07	-0.25	5.53	6.01	0.48**
Warm-Cool	4.90	4.87	-0.03	4.85	4.95	0.10
Attractive-Unattractive	4.19	4.00	-0.19	4.86	5.28	0.42*
Quiet-Noisy	6.00	5.33	-0.67	5.99	5.16	-0.83

[z]EAS (Rohles and Milliken, 1981) is based on a nine-point scale (1 = the least desirable, 9 = the most desirable).
[y]Differences in EAS scores of pre-test (self-rated before surgery) and post-test (self-rated at the last day of hospitalization), were computed.
* $P < 0.05$ (compared with control).
** $P < 0.01$ (compared with control).

CHAPTER 2 - EFFECTS OF EXPOSURE TO PLANTS IN HOSPITAL ROOMS ON PATIENTS RECOVERING FROM ABDOMINAL SURGERY[2]

[2]For submission to Journal of the American Society for Horticultural Science

Abstract

Using various medical and psychological measurements, this study performed a randomized clinical trial with surgical patients to evaluate whether plants in hospital rooms might have therapeutic influences. Ninety patients recovering from an appendectomy were randomly assigned to hospital rooms with or without indoor plants. Patients in the plant treatment room viewed eight species of foliage and flowering plants during their postoperative recovery periods. Data collected for each patient included length of hospitalization, analgesics used for postoperative pain control, vital signs, ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ). Effects were assessed by analysis of covariance and the exact chi-square test. Patients in hospital rooms with plants and flowers had significantly fewer intakes of postoperative analgesics, more positive physiological responses evidenced by lower systolic blood pressure and heart rate, lower ratings of pain and anxiety, and more positive feelings and higher satisfaction about their rooms than patients in the control group. Findings of this research confirmed the therapeutic value of plants in the hospital environment as a noninvasive, inexpensive, and effective intervention for surgical patients in a general hospital ward.

Introduction

Appendectomy is an acute surgery characterized by localized abdominal pain requiring relatively short hospitalization of up to five days. This is a comparatively standardized medical procedure with similar postoperative management in the uncomplicated cases. Appendectomy surgery, however, may create multiple stressors to patients, including pain and physical discomfort, fear of medical procedures, isolation from family and friends, and lack of familiarity with medical personnel, hospital equipment and environment. Numerous studies suggest that when patients have greater stress associated with surgery, they typically experience more severe postoperative pain, and a slower and more complicated postoperative recovery (Cohen and Williamson, 1991; Johnston, 1988; Johnston and Wallace, 1990; Mathews and Ridgeway, 1981). Some of the postoperative problems related to stress can be mediated through intakes of anesthetics and analgesics. However, these drugs have side effects, which can produce postoperative behavioral problems (e.g., vomiting, headaches, nausea, and pain at the incisional site), drug dependency, and even be fatal if not properly administered (Abbott and Abbott, 1995; Coniam and Diamond, 1994). Therefore, it would be useful to develop nonpharmacologic approaches to improving the patient experiences with pain and stress during hospitalization.

To promote speed of postoperative recovery and to improve quality of life during hospitalization, it is important to provide patients not only the best treatment possible, but also to remove such sources of stress and to counter them with positive distractions, which have soothing and stress-reducing effects. Nature/plants have been considered as one of the most effective positive distractions, which may provide ample involuntary attention, increase positive feelings, block or reduce worrisome thoughts, and promote restoration from stress (Ulrich, 1992). Researchers who have assessed the impact of nature/plants on human health suggested that they provide the preferred form of physiologically measurable stress reduction (Chang and Chen, 2005; Coleman and Mattson, 1995; Doxon et al., 1987; Verderber and Reuman, 1987; Lohr et al., 1996; Ulrich et al., 1991). This relaxation occurs remarkably quickly, almost within minutes (Ulrich and Simons, 1986). People in a natural/plant environment not only showed faster physical recovery from stress, but also improved psychological (Kaplan, 2001; Kaplan and Kaplan, 1995; Ulrich, 1979), emotional (Adachi et al., 2000; Ulrich, 1981; Ulrich et al., 1991), and cognitive health (Cimprich, 1993; Hartig et al., 1991; Tennessen and Cimprich, 1995). In addition, viewing nature/plants is linked to positive health outcomes of individuals, such as pain reduction, less need for analgesics, and faster recovery from surgery (Diette et al., 2003; Lohr and Pearson-Mims, 2000; Park et al., 2004; Ulrich, 1984; Ulrich et al., 1993).

Clinical trials involving plants within a hospital setting concerning the health benefits of indoor plants on stress and recovery of surgical patients do not exist. The purpose of this investigation was to determine if plants in hospital rooms had therapeutic influences on health outcomes of appendectomy patients using various medical and psychological measurements.

Materials and Methods

Subjects

The sample consisted exclusively of patients who had undergone appendectomy surgery. Ninety patients (52 males and 38 females, mean age = 37.6 ± 9.41 years ranging from 21 to 60) were studied from July 2005 to January 2006 in a 250-bed suburban hospital in Korea. This study was approved by the institution review boards of both the academic and practice setting concerning human research protocols. Patients were informed that their medical history and current medical records would be reviewed and each signed an informed consent form. Patients were randomly assigned to either control or plant rooms (Fig. 2.1) as they became available. The rooms, which were located on the same floor and the same side of the building, were identical except for the presence or absence of plants (Appendix A). Patients in the plant group were exposed to plants during their recovery periods following surgery until discharge. Excluded from the study were patients who were younger than 19 years or older than 60, and those who reported chronic (e.g., diabetes, high blood pressure) or current acute (e.g., upper respiratory infection) health problem, a history of psychiatric problems (e.g., depression, anxiety), or uncorrected hearing or visual impairments. Subjects averaged 13.6 years of formal education, and 41% were college graduates. All were born in Korea. The majority was married (71%). All were in good health prior to diagnosis of surgical treatment.

Measurements

Medical and psychological data were collected from each patient. This included length of hospitalization, analgesics used for postoperative pain control, vital signs, ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ).

Outcome data of length of hospitalization, postoperative analgesic intakes and vital signs were extracted from patient charts. Length of hospitalization was defined as days from surgery to discharge. Postoperative analgesics were classified as weak, moderate, or strong on the basis of the drug and amount, and whether it was narcotic or not. The weak category was dominated by small amounts of diclofenac sodium injections, a nonsteroidal anti-inflammatory drug (NSAID), and the moderate category included large amounts of diclofenac sodium injections up to 150mg per day. In the strong category, pethidine hydrochloride injections (narcotic analgesics) were used. Vital signs recorded were systolic and diastolic blood pressures (mmHg), body temperature (°C), heart rate (beat per minute), and respiratory rates (breaths per minute).

They were defined as the average of three readings taken per day. All measurements were taken using standard, noninvasive technology and recorded on patient charts.

Levels of PPAF were measured using a 101-point numerical rating scale (NRS-101) (Appendix A). The validity of the NRS-101 and its sensitivity to treatment effects has been well documented (Jensen et al., 1986; Jensen and Karoly, 1992; Seymour, 1982). The NRS-101 is reported to have several advantages over the other rating scales and to be more sensitive to treatment effect than the NRS-11 (rating from 1 to 10) due to a large number of response categories (Jensen et al., 1986).

The Spielberger's State-Trait Anxiety Inventory Form Y (STAI-Y) (Spielberger, 1983) is comprised of a self-report measurement of anxiety and has been used extensively in research and clinical practice. The STAI consists of two scales. The STAI-Y1 scale includes twenty statements intended to measure transitory feelings of tension, nervousness, apprehension, and worry while the STAI-Y2 section evaluates the stable personality trait of anxiety proneness. This study used STAI-Y1 because it was expected for measure assessing changes in anxiety resulting from situational stress (Appendix A). Psychometric properties of the STAI-Y and studies supporting its construct validity are presented in the STAI-Y manual (Spielberger, 1983).

To measure patients' feelings in response to their hospital rooms, the modified EAS (Rohles and Milliken, 1981) was used (Appendix A). The EAS consists of 13 adjective pair semantic differential scales. EAS has been used in previous studies to evaluate the affective characteristics of the environment and various features it contains (Laviana, 1985; Laviana et al., 1983).

To assess patient satisfaction with the patient room, patients were asked to complete PRSQ, which indicates three positive and three negative qualities of their room environments (Appendix

A). Patients were further asked the willingness to return to their hospital room in any future hospitalization. Space was provided so that patients could add comments.

Procedures

After obtaining the informed consent agreement and after health screening, measurements of the PPAF, STAI-Y1, and EAS were administered at the patient room. Twelve potted foliage and flowering plants with sterile, soilless potting mix were placed in the hospital room after patients left the room for surgery. Plants selected for hospital room were *Dendrobium phalaenopsis* (Orchid), *Spathiphyllum* 'Starlight' (Peace Lily), *Epipremnum aureum* (Golden Pothos), *Howea forsteriana* (Kentia palm), *Syngonium podophyllum* 'Albolineatum' (Arrowhead Vine), *Pteris cretica* 'Albolineata'(Cretan Brake Fern), *Vinca minor* 'Illumination'(Vinca), and *Trachelospermum asiaticum* 'Ougonnishiki'(Yellow star jasmine). Hospital rooms had large windows with natural sunlight during the daytime unless shades were drawn. From July through December, although the length of the natural photoperiod declined, photoperiod was similar throughout the study with interior room lighting. Consistent temperature and humidity for patient comfort level were similar to those required by the plants selected. Plant selection was based on space consideration, sunlight accessibility, requirements of temperature and humidity, low maintenance, and visual appeal with various colors, sizes, patterns, and shapes. Plants were added or removed as needed to accomplish each treatment. Each plant treatment room had similar types of plants; control rooms contained no plant materials. Plants were grown in self-watering containers and patients were not disturbed by plant maintenance during hospitalizations. To control for effects of the researcher, the patients were blind in the sense the researcher related to plants. Patients were not told about the study objectives or how to utilize the plant intervention. During the first three days after surgery, measurements of the PPAF and STAI-Y1 were administered at mid-morning. The second trial of EAS and the initial trial of PRSQ were administered at the last day of hospitalization. All measurements were taken by the researcher except demographics, analgesic intakes, and vital signs, which were recorded by medical staff.

Data analyses

Analysis of covariance (ANCOVA) (Littell et al., 2006) using SAS PROC GLM (SAS Institute Inc., 2000) was used for all data analyses except analgesic data to test for differences between groups. Age was used as the covariate in ANCOVA to evaluate whether the age on the patients' responses are effective. The exact chi-square test (Higgins, 2004) using SAS PROC FREQ (SAS Institute Inc., 2000) was used to compare the groups for analgesic intakes. The strength of analgesic categories used for postoperative pain control was computed for differences between groups for the day of surgery, first day after surgery, second day after surgery, and third day after surgery. Alpha level was set at 0.05.

Results and Discussion

Mean length of hospitalizations for the plant group was 4.64 days and was not significantly different from that of the control group at 4.88 days. Analgesic intakes (Fig. 2.2) were significantly different for the plant group as compared to the control group at the third day after surgery (p=0.041). Patients exposed to plants were less frequently given weak and moderate analgesics as compared to patients in the control group. On the day of surgery, there were significant differences in systolic blood pressure (p=0.043) and heart rate (p=0.04), which was significantly lower with the plant group, as compared to the control group (Fig. 2.3, Fig. 2.4, respectively). No differences were noted between the groups regarding diastolic blood pressure, temperature, and respiratory rate through the recovery periods (Appendix B).

Viewing plants made a statistically significant impact on differences in ratings of pain intensity, pain distress, and anxiety (Table 2.1). Levels of pain intensity decreased for most patients in both groups through the recovery periods. Self-rated pain intensity was significantly lower for those patients exposed to plants as compared to no plants at the third day after surgery (p=0.02). Levels of pain distress also decreased for most patients in both groups through the recovery periods. The dynamic changes of pain distress were parallel with that of pain intensity and consistently lower than the pain intensity ratings. Patients in the plant group also had significantly less ratings of pain distress on the third day after surgery compared to patients in the control group (p=0.03). Anxiety levels were highest before surgery and remarkably decreased for most patients in both groups through the recovery periods. Comparing plant group patients to control group patients, self-rated anxiety was significantly lower at the first and second days after surgery (p=0.02, p=0.04, respectively). Fatigue levels remarkably decreased for most patients in both groups through the recovery periods; however, no significant differences between groups were obtained (Appendix B). For the STAI-Y1, statistically significant differences emerged between the two groups (Table 2.1). Patients in the plant group were characterized by significantly lower levels of state anxiety than patients in the control group at the first and second days after surgery (p=0.032, p=0.034, respectively). This result was consistent with that of anxiety NRS-101 ratings.

Significant differences between EAS responses of two groups were found for the seven items (Table 2.2). EAS responses to plants indicated that patients through the recovery periods felt their rooms more satisfying, relaxing, comfortable, colorful, pleasant smell, calming, and attractive, as compared to those in the control rooms.

Results of PRSQ showed the majority of patients in the plant rooms indicated that plants were the most positive qualities of their rooms (93%), while patients in the control group most favorably reported television (91%). The next categories of positive qualities regarding the hospital room included appropriate temperature (77%), television (66%), and sunshine (44%) for the plant group; and appropriate temperature (71%), sunshine (44%), and quietness (11%) for the control group. Regarding negative qualities of hospital room, patients in the control and plant rooms had similar negative comments concerning toilet facilities, insufficient space, and the hospital environment. Patients were further asked the willingness to return to their hospital room in any future hospitalization. Ninety-one % of patients in the plant group responded positively, while 71% of patients in the control group reported a willingness to return.

Voluntary comments of plant group patients were collected from nurses, the researcher, and self-writings from PRSQ (Appendix B.) Many patients stated that plants helped them relax or feel less anxious. Plants were associated with positive memories, and some patients believed that plants had diminished their pain. Further, the presence of plants in the hospital room promoted a positive image of the hospital as a healing environment and a place designed to be sensitive to patient needs. As patients recovered from surgery and regained mobility, nursing and medical staff reported increased interaction with plants. This included watering plants, removing dead leaves, touching them, and moving them for better view or close to window for better sunlight.

Unlike cut flowers, potted foliage and flowering plants are likely to remain for long periods of time. During the seven months of the study period, seven species of plants maintained their qualities, and only orchids needed to be replaced every two months due to flower deterioration. The daily cost of the plants and their maintenance per room over the study period was approximately $1.37, which were considerably lower than the costs of analgesic consumptions.

In most hospitals, plants and dried or fresh flowers may not be allowed in the hospital rooms because it is commonly believed they could introduce potential pathogens into a hospital, and they might also induce a reservoir of hospital bacterial strains. The potential risk of infection arising from plants and their growth medium, however, is based on anecdotal evidence only. There is no scientific evidence that flowers, foliage plants, water in flower vases, or medium in the plant container have spread disease in hospitals and have been considered at risk, except with patients in immunocompromised and intensive care units (Centers for Disease Control and Prevention, 2003; Gould et al., 2004). Bartzokas et al. (1975) demonstrated that while large numbers of pathogens may be cultured from the water in flower vases, they were not the same strains as the bacteria responsible for causing infection among nearby patients. Siegman-Igra et al. (1986) drew similar conclusions with potted plants. They selected three to seven potted plants randomly from six surgical wards (general, vascular, urologic, orthopedic, neurosurgical, and thoracic) and obtained 79 isolates of Gram-negative bacteria from 29 plants. The finding revealed, however, there was no relationship between the organisms isolated in the soil of the plants and the 235 isolates obtained from nearby patients throughout the study period. All the plants were positioned in areas of major activity including patient dining table, nursing station and medication preparation alcove. Some researchers commented that practical solutions exist to reduce infection and the other risks attached to plants by sensible infection control precautions, such as hygienic hand washing and wearing gloves (Wenzel et al., 1998).

A number of studies have shown that indoor plants make air healthier, and provide an optimum indoor environment. The presence of plants reduced sick-building syndrome by removing pollutants (Darlington et al., 2001; Nishida et al., 1991; Wolverton, 1997; Wolverton et al., 1989; Wood et al., 2002), increased relative humidity up to human comfort level (Lohr, 1992; Wolverton and Wolverton, 1993), and improved indoor air quality by reducing the quantity of mold spores and air borne microorganisms (Wolverton and Wolverton, 1993).

Previous research (Park et al., 2004) in a simulated hospital room indicated that pain sensitivity and perception were significantly decreased when foliage and flowering plants were present, as compared to just foliage or a room without any plants or flowers. A study of patients recovering from abdominal surgery found that individuals had shorter hospital stays, fewer negative comments in nurses' notes, and fewer intakes of analgesics if their bedside windows overlooked trees rather than a brick wall (Ulrich, 1984). This study extends earlier studies documenting the health benefits of passively viewing plants. The finding of this study confirmed that introducing indoor plants in hospital room during recovery period had a positive influence linking directly to health outcomes of surgical patients. Patients exposed to plants had significantly less need for analgesics, enhanced physiological responses, lower ratings of pain and anxiety, and more positive feelings and higher satisfaction about their hospital rooms, compared to patients without plants.

Colorful fresh flowers and blooming or green plants could be a good medicine for patients. If properly maintained, indoor plants can provide a great opportunity for patients to experience nature in all seasons when outdoor scenery could not provide this benefit. Further, they can provide meaningful therapeutic contact for, especially, patients spend much of their time indoors while recovering from painful surgery.

Findings of this study may not be applied to the immediate environments of severely immunocompromised and intensive care unit patients. However, this study provided strong evidence that contact with plants is directly beneficial to patients' health, and there is no reason to prohibit plants and flowers from a general hospital ward. This nonpharmacological and noninvasive approach is medically beneficial and clearly cost-effective to not only patients, but also hospital administrators and insurance companies by reducing costs of hospitalizations, analgesic consumptions, and health insurance. Outcomes research may have influence on administrators' decisions concerning which treatment and therapeutic condition will be made available to and paid for by patients or insurance companies.

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Figures and Tables

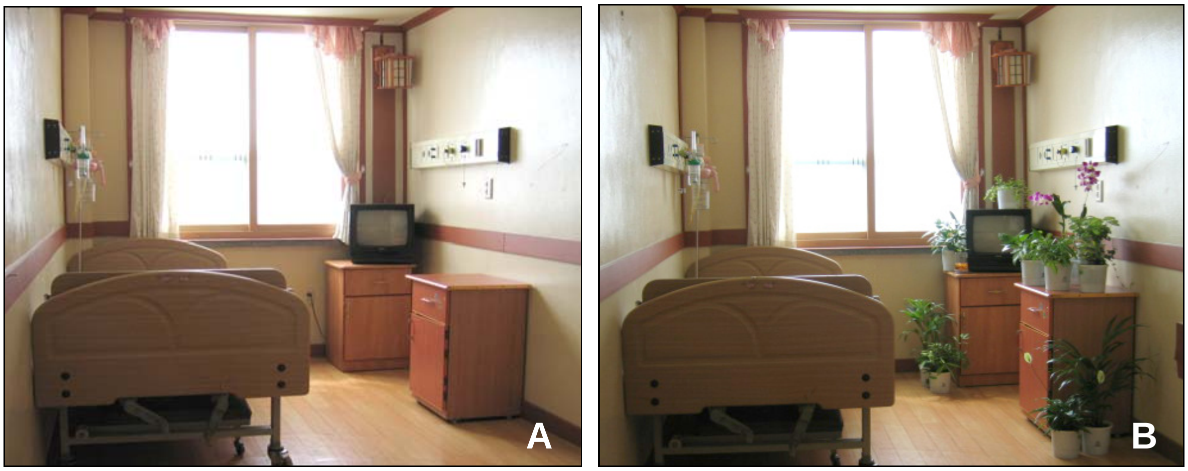

Fig. 2.1. Photographs of the two treatments: (A) no plants and (B) foliage and flowering plants.

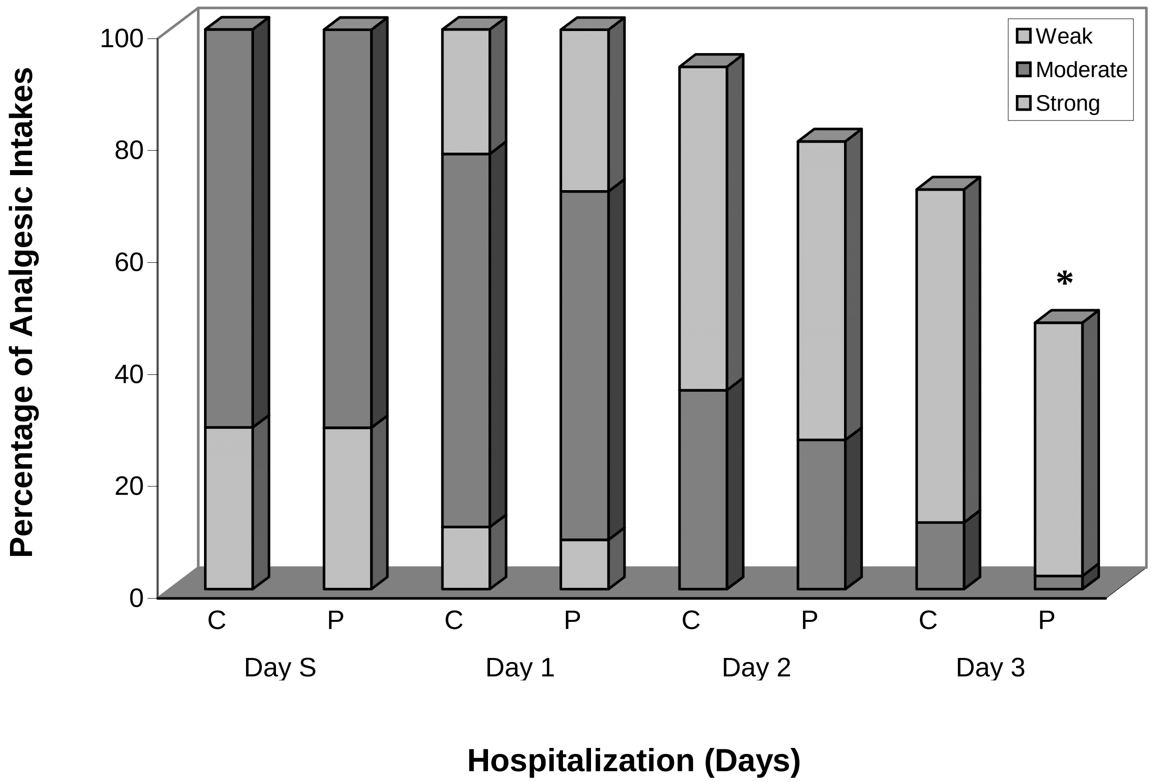

Fig. 2.2. Comparisons of control (C) and plant (P) groups in postoperative analgesic intakes. Day S, Day 1, Day 2, and Day 3 indicate the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively.

* $P < 0.05$ (compared with control).

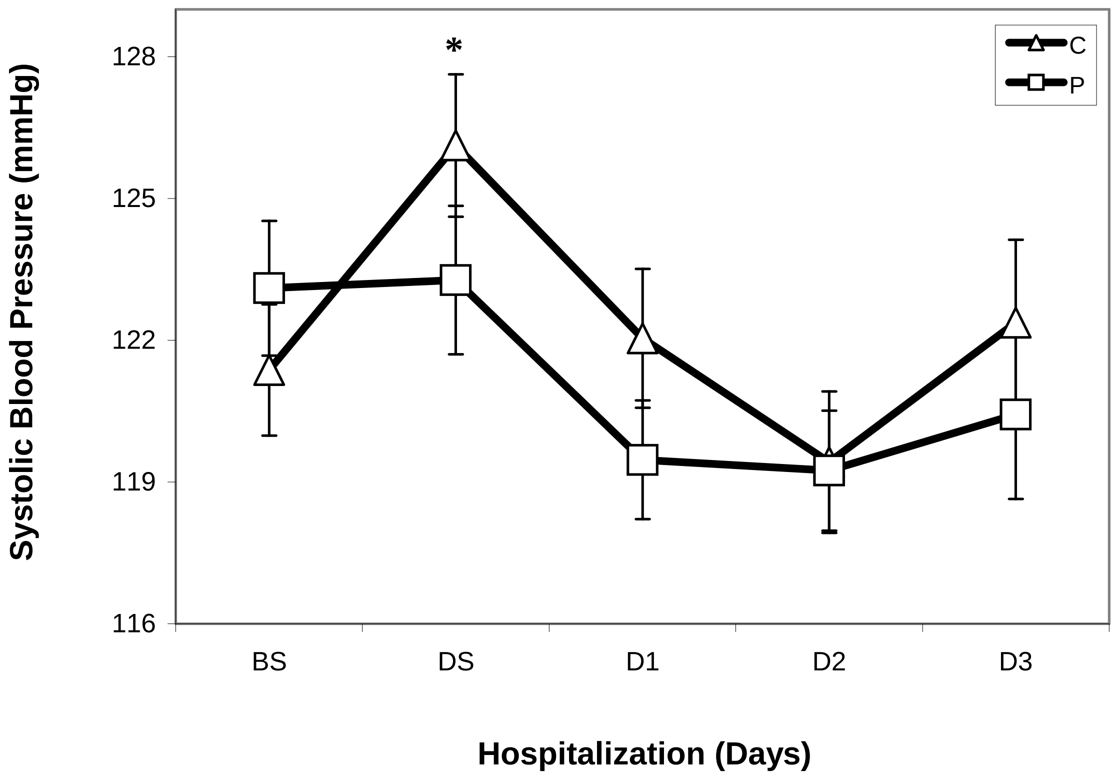

Fig. 2.3. Comparisons of control (C) and plant (P) groups in systolic blood pressure. Error bars label S.E. of estimates. BS, DS, D1, D2, and D3 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively. * Control vs. plants, $P < 0.05$.

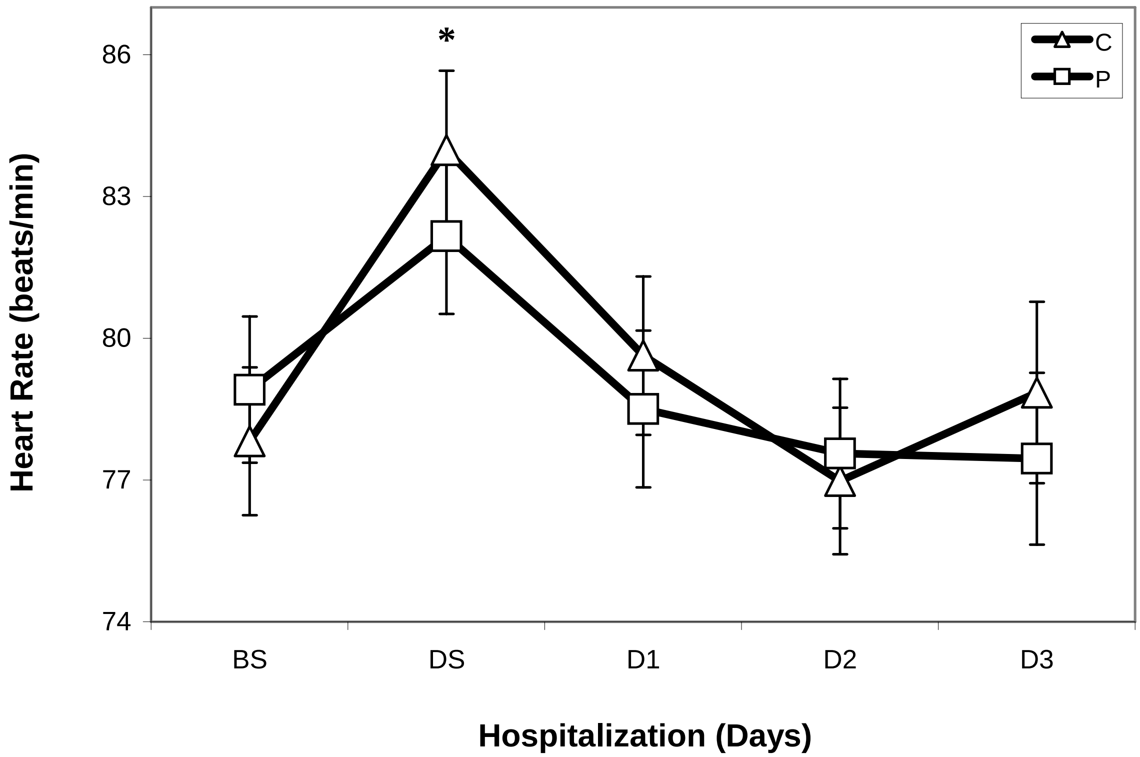

Fig. 2.4. Comparisons of control (C) and plant (P) groups in heart rate. Error bars label S.E. of estimates. BS, DS, D1, D2, and D3 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively. * Control vs. plants, $P < 0.05$.

Table 2.1. Mean and standard deviation (SD) of control (C) and plant (P) groups in the rated for pain intensity, pain distress, anxiety, and STAI-Y1.

	Pain Intensity[z]		Pain Distress[z]		Anxiety[z]		STAI-Y1[y]	
	C	P	C	P	C	P	C	P
BS	66.44 (13.29)	69.02 (12.63)	65.20 (9.76)	67.96 (9.74)	74.68 (8.69)	76.89 (8.11)	49.04 (5.82)	50.84 (6.29)
D1	87.90 (8.01)	88.13 (7.58)	86.56 (7.82)	86.34 (9.23)	49.74 (6.40)	46.87* (9.50)	44.02 (5.44)	41.97* (5.12)
D2	77.42 (9.86)	73.14 (11.15)	69.54 (10.40)	66.41 (11.30)	32.53 (7.11)	29.94* (9.63)	35.64 (5.23)	33.43* (5.40)
D3	58.65 (10.79)	53.03* (10.84)	54.16 (9.34)	49.56* (10.54)	17.57 (6.83)	15.28 (5.53)	30.38 (4.34)	28.82 (3.45)

BS = before surgery; D1 = first day after surgery; D2 = second day after surgery; D3 = third day after surgery.

[z]Pain intensity: 0 = no pain, 100 = pain as bad as it could be; Pain distress: 0 = comfortable, 100 = excruciating; Anxiety: 0 = complete relaxation, 100 = the worst feelings of anxiety.

[y]Twenty items (ten anxiety-present items and ten anxiety-absent items) were given a weighted score of 1 to 4 (1 = not at all, 2 = somewhat, 3 = moderately, 4 = very much). A rating of 4 indicates the presence of a high level of anxiety for ten anxiety-present items and the anxiety-absent items for which the scoring weights are reversed. Scores are ranging from 20 to 80. A lower value indicates less anxiety.

* $P < 0.05$ (compared with control).

Table 2.2. Mean changes in the 13 items of the Environmental Assessment Scale (EAS)[z] self-rated by patients with appendectomy (45 patients per group) before surgery and at the last day of hospitalization, in responses to viewing 'foliage and flowering plants' and 'no plants' during recovery.

Items	Control Group			Plant Group		
	Pre	Post	Post-Pre[y]	Pre	Post	Post-Pre[y]
Satisfying-Annoying	6.16	5.91	-0.25	6.30	6.64	0.34*
Clean-Dirty	6.42	6.18	-0.24	5.88	5.81	-0.07
Relaxing-Stressing	5.65	5.48	-0.17	5.83	6.53	0.70**
Comfortable-Uncomfortable	5.74	5.61	-0.13	5.86	6.46	0.60**
Colorful-Drab	4.69	4.81	0.12	4.63	6.75	2.12**
Happy-Sad	4.76	4.85	0.09	4.90	5.44	0.54
Pleasant smell-Unpleasant smell	4.59	4.54	-0.05	4.79	5.15	0.36*
Bright-Dull	7.30	7.39	0.09	7.05	7.13	0.08
Spacious-Crowded	6.07	5.98	-0.09	5.90	5.69	-0.21
Calming-Irritating	5.88	5.70	-0.18	5.90	6.44	0.54*
Warm-Cool	5.00	5.11	0.11	5.01	5.04	0.03
Attractive-Unattractive	4.77	4.68	-0.09	4.70	5.89	1.19**
Quiet-Noisy	6.16	6.25	0.09	6.31	6.27	-0.04

[z]EAS (Rohles and Miliken, 1981) is based on a nine-point scale (1 = the least desirable, 9 = the most desirable).
[y]Differences in EAS scores of pre-test (self-rated before surgery) and post-test (self-rated at the last day of hospitalization), were computed.
* $P < 0.05$ (compared with control).
** $P < 0.01$ (compared with control).

CHAPTER 3 - ORNAMENTAL INDOOR PLANTS IN HOSPITAL ROOMS ENHANCED HEALTH OUTCOMES OF PATIENTS RECOVERING FROM SURGERY[3]

[3]For submission to HortScience.

Abstract

Medical and psychological measurements of surgical patients were tested to determine the influence of plants and flowers within hospital rooms. Ninety patients were randomly assigned to either control or plant rooms. Patients in the plant group were exposed to plants during their recovery periods following surgery until discharge. Data collected for each patient included length of hospitalization, analgesics used for postoperative pain control, vital signs, ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ). Effects were assessed by analysis of covariance and the exact chi-square test. Patients in hospital rooms with plants and flowers had significantly more positive physiological responses evidenced by lower systolic blood pressure and respiratory rate, lower ratings of pain, anxiety and fatigue, and more positive feelings and higher satisfaction about their rooms than patients in similar rooms without plants. Findings of this study confirmed the therapeutic value of plants in the hospital environment as a noninvasive, inexpensive and effective intervention for surgical patients in a general hospital ward.

Introduction

Hemorrhoidectomy is an acute surgery characterized by localized anal pain requiring relatively short hospitalization of up to four days. This is a comparatively standardized medical procedure with similar postoperative management in the uncomplicated cases. Hemorrhoidectomy surgery, however, may create multiple stressors to patients, including pain and physical discomfort, fear of medical procedures, separation from family, and lack of familiarity with medical personnel, hospital equipment and environment. Previous researchers have reported that greater stress related to surgical experience is typically related to more severe postoperative pain and adversely affects the ability of patients to cope with and recovery from illness (Cohen and Williamson, 1991; Johnston, 1988; Johnston and Wallace, 1990; Mathews and Ridgeway, 1981). Some of the postoperative problems related to stress can be mediated through intakes of anesthetics and analgesics, however, these drugs have side effects, which can produce postoperative behavioral problems (e.g., vomiting, headaches, nausea, and pain at the incisional site), drug dependency, and even be fatal if not properly administered (Abbott and Abbott, 1995; Coniam and Diamond, 1994). Therefore, it would be useful to develop nonpharmacologic approaches to improving the patient experiences with pain and stress during hospitalization.

To promote faster postoperative recovery during hospitalization, it is important to remove stressors and to provide positive distractions, which have soothing and stress-reducing effects. Nature/plants are effective positive distractions, which provide involuntary attention, increase positive feelings, block or reduce worrisome thoughts, and promote restoration from stress (Ulrich, 1992). Research has demonstrated that whether passive or active contact, nature/plants brings about positive psychological (Kaplan, 2001; Kaplan and Kaplan, 1995; Ulrich, 1979), physiological (Chang and Chen, 2005; Coleman and Mattson, 1995; Doxon et al., 1987; Verderber and Reuman, 1987; Lohr et al., 1996; Ulrich et al., 1991), emotional (Adachi et al., 2000; Ulrich, 1981; Ulrich et al., 1991), and cognitive changes (Cimprich, 1993; Hartig et al., 1991; Tennessen and Cimprich, 1995) that reduce stress and improve the quality of life for the individual. Several studies have also shown that the presence of nature/plants contributed to pain reduction, less need for analgesics, and faster recovery from surgery (Diette et al., 2003; Lohr and Pearson-Mims, 2000; Park et al., 2004; Ulrich, 1984; Ulrich et al., 1993).

Clinical trials have not been reported involving the health benefits of indoor plants on stress and recovery of surgical patients. The purpose of this investigation was to determine whether exposing surgical patients to plants has positive influences on health outcomes using various medical and psychological measurements.

Materials and Methods

Subjects

The sample consisted exclusively of patients who had undergone hemorrhoidectomy surgery. Ninety patients (43 males and 47 females, mean age = 47 ± 9.38 years ranging from 24 to 60) were studied from July 2005 to January 2006 in a 250-bed suburban hospital in Korea. This study was approved by the institution review boards of both the academic and practice setting concerning human research protocols. Patients were informed that their medical history and current medical records would be reviewed and each signed an informed consent form. Patients were randomly assigned to either control or plant rooms (Fig. 3.1) as they became available. The rooms, which were located on the same floor and the same side of the building (Appendix A), were identical except for the presence or absence of plants. Patients in the plant group were exposed to plants during recovery periods following surgery until discharge. Excluded from the study were patients who were younger than 19 years or older than 60, and those who reported chronic (e.g., diabetes, high blood pressure) or current acute (e.g., upper respiratory infection) health problem, a history of psychiatric problems (e.g., depression, anxiety), or uncorrected hearing or visual impairments. Subjects averaged 12.9 years of formal education, and 35% were college graduates. All were born in Korea. The majority was married (84%). All were in good health prior to diagnosis of surgical treatment.

Measurements

Medical and psychological data were collected from each patient. This included length of hospitalization, analgesics used for postoperative pain control, vital signs, ratings of pain intensity, pain distress, anxiety and fatigue (PPAF), the State-Trait Anxiety Inventory Form Y-1 (STAI-Y1), the Environmental Assessment Scale (EAS), and the Patient's Room Satisfaction Questionnaire (PRSQ).

Outcome data of length of hospitalization, analgesic intakes and vital signs were extracted from patient charts. Length of hospitalization was defined as days from surgery to discharge. Postoperative analgesics were classified as weak, moderate, or strong on the basis of the drug and amount, and whether it was narcotic or not. The weak category was dominated by small amounts of diclofenac sodium injections, a nonsteroidal anti-inflammatory drug (NSAID), and the moderate category included large amounts of diclofenac sodium injections up to 150mg per day. In the strong category, pethidine hydrochloride injections (narcotic analgesics) were used. Vital signs recorded were systolic and diastolic blood pressures (mmHg), body temperature (°C), heart rate (beat per minute), and respiratory rates (breaths per minute). They were defined as the average of three medical readings taken per day. All measurements were done by medical staff using standard, noninvasive technology and recorded on patient charts.

Levels of PPAF were measured using a 101-point numerical rating scale (NRS-101) (Appendix A). The validity of the NRS-101 and its sensitivity to treatment effects has been well documented (Jensen et al., 1986; Jensen and Karoly, 1992; Seymour, 1982).

The Spielberger's State-Trait Anxiety Inventory Form Y-1 (STAI-Y1) (Spielberger, 1983) is comprised of a self-report measurement of anxiety and has been used extensively in research and clinical practice. The STAI-Y1 scale includes twenty statements intended to measure transitory feelings of anxiety, tension, nervousness, apprehension, and worry resulting from situational stress (Appendix A). Psychometric properties of the STAI-Y1 and studies supporting its construct validity are presented in the STAI-Y1 manual (Spielberger, 1983).

To measure patients' feelings in response to their hospital rooms, the modified EAS (Rohles and Milliken, 1981) was used (Appendix A). The EAS consists of 13 adjective pair semantic differential scales. EAS has been used in previous studies to evaluate the affective characteristics of the environment and various features it contains (Laviana, 1985; Laviana et al., 1983).

To assess patient satisfaction with the patient room, patients were asked to complete PRSQ, which indicates three positive and three negative qualities of their room environments (Appendix A). Patients were further asked the willingness to return to their hospital room in any future hospitalization. Space was provided so that patients could add comments.

Procedures

After obtaining the informed consent agreement and after health screening, measurements of the PPAF, STAI-Y1, and EAS were administered at the hospital room about 30 minutes after arrival. Twelve potted foliage and flowering plants with sterile, soilless potting mix were placed in the hospital room after patients left the room for surgery. Plants selected for hospital rooms were *Dendrobium phalaenopsis* (Orchid), *Spathiphyllum* 'Starlight' (Peace Lily), *Epipremnum aureum* (Golden Pothos), *Howea forsteriana* (Kentia palm), *Syngonium podophyllum*

‘Albolineatum’ (Arrowhead Vine), *Pteris cretica* ‘Albolineata’(Cretan Brake Fern), *Vinca minor* ‘Illumination’(Vinca), and *Trachelospermum asiaticum* ‘Ougonnishiki’(Yellow star jasmine). Hospital rooms had large windows with natural sunlight during the daytime unless shades were drawn. From July through December, although the length of the natural photoperiod shortened, photoperiod was similar throughout the study with interior room lighting. Consistent temperature and humidity for patient comfort level were similar to those required by the plants selected. Plant selection was based on space consideration, sunlight accessibility, requirements of temperature and humidity, low maintenance, and visual appeal with various colors, sizes, patterns, and shapes. Plants were added or removed as needed to accomplish each treatment. Each plant treatment room had similar types of plants, while no plants were allowed in the control rooms. Plants were grown in self-watering containers and patients were not disturbed by plant maintenance during hospitalizations. To control for effects of the researcher, the patients were blind in the sense the researcher related to plants. Patients were not told about the study objectives or how to utilize the plant intervention. After the surgery and the first and second days after surgery, measurements of the PPAF and STAI-Y1 were administered. The second trial of EAS and the initial trial of PRSQ were administered at the last day of hospitalization. All measurements were taken by the researcher except demographics, analgesic intakes, and vital signs, which were recorded by medical staff.

Data analyses

Analysis of covariance (ANCOVA) (Littell et al., 2006) using SAS PROC GLM (SAS Institute Inc., 2000) was used for all data analyses except analgesic data to test for differences between groups. Age was used as the covariate in ANCOVA to evaluate whether the age on the patients' responses are effective. The exact chi-square test (Higgins, 2004) using SAS PROC FREQ (SAS Institute Inc., 2000) was used to compare the groups for analgesic intakes. The strength of analgesic categories used for postoperative pain control was computed for differences between groups for the day of surgery, first day after surgery, and second day after surgery. Alpha level was set at 0.05.

Results and Discussion

Although the means for days of hospitalizations and numbers of postoperative analgesic intakes were lower for patients in the plant group as compared to the control group, there were no statistically significant differences between the groups (Appendix B). On the first day after surgery, there were significant differences in systolic blood pressure (p=0.037) and respiratory rate (p=0.043), which was lower with the plant group as compared to the control group (Fig. 3.2, Fig. 3.3, respectively). No differences were noted between the groups regarding diastolic blood pressure, temperature, and heart rate through the recovery periods (Appendix B).

Viewing plants made a statistically significant impact on differences in ratings of PPAF (Table 3.1). Levels of pain intensity decreased for most patients in both groups through the recovery periods. Self-rated pain intensity was significantly lower for those patients exposed to plants as compared to no plants at the first and second days after surgery (p=0.015, p=0.041, respectively). Levels of pain distress also decreased for most patients in both groups through the recovery periods. The dynamic changes of pain distress were parallel with that of pain intensity and consistently lower than the pain intensity ratings. Patients in the plant group also had significantly less ratings of pain distress on the first day after surgery compared to patients in the control group (p=0.04). Anxiety levels were highest before surgery and remarkably decreased for most patients in both groups through the recovery periods. Comparing the plant group patients to the control group patients, self-rated anxiety was significantly lower at the day of surgery and the first and second days after surgery (p=0.016, p=0.02, p=0.035, respectively). Fatigue levels remarkably decreased for most patients in both groups through the recovery period. Significant differences between the groups for fatigue levels were obtained at the first day after surgery (p=0.046). For the STAI-Y1, there were statistically significant differences emerged between the two groups (Table 3.1). Patients in the plant group were characterized by significantly lower levels of state anxiety than patients in the control group at the day of surgery and the first and second days after surgery (p=0.021, p=0.01, p=0.04 respectively). This result was consistent with that of anxiety NRS-101 ratings.

Significant differences between EAS responses of two groups were found for the eight items (Table 3.2). EAS responses to plants indicated that patients through the recovery periods felt their rooms more satisfying, clean, relaxing, comfortable, colorful, happy, calming, and attractive, as compared to those in the control rooms.

Results of PRSQ showed the majority of patients in the plant group indicated that plants were the most positive qualities of their rooms (96%), while patients in the control group most favorably reported appropriate temperature (88%). The next categories of positive qualities regarding hospital room included sunshine (80%), appropriate temperature (67%), and television (44%) for the plant group; and television (86%), sunshine (71%), and quietness (22%) for the control group. Regarding negative qualities of the hospital room, patients in the control and plant rooms had similar negative comments concerning toilet facilities, insufficient space, and the hospital environment. Patients were further asked the willingness to return to their hospital room in any future hospitalization. Ninety-three % of patients in the plant group responded positively, while 73% of patients in the control group were likely to return.

The comments, which were voluntary expressions of patients in plant group, were collected by nurses, the researcher, and self-writings from PRSQ. Patients in the plant group offered these descriptions of their experiences with plants.

> "When I had surgery previously, I woke up tense, which made my pain worse. That didn't happen this time. Maybe plants help me relax."
>
> "Orchids were beautiful. I got so involved in them."
>
> "I love plants in my room. Do you know those names?"
>
> "I truly enjoyed watching plants in my room. All patients should have this opportunity."
>
> "I've never seen or heard before that hospital provides beautiful plants for patients. I feel like I am lucky."
>
> "Plants make a room homelike. They make me feel better."

Many patients stated that plants helped them relax or feel less anxious, and some believed that plants had diminished their pain. The presence of plants in the hospital room also contributed to building a positive image of a hospital to patients, showing that the hospital is sensitive to the healing potential of "nearby nature" in the hospital environment. As patients recovered from surgery and regained mobility, nursing and medical staff reported increased interaction with plants. This included watering plants, removing dead leaves, touching them, and moving them for better view or close to window for better sunlight.

Unlike cut flowers, potted foliage and flowering plants are likely to remain for long periods of time. During the seven months of the study period, seven species of plants maintained their qualities, and only orchids needed to be replaced every two months due to flower deterioration. The daily cost of the plants and their maintenance over the study period was inexpensive.

Previous research (Park et al., 2004) in a simulated hospital room indicated that pain sensitivity and perception were significantly decreased when foliage and flowering plants were present, as compared to just foliage or a room without any plants or flowers. A study of patients recovering from abdominal surgery found that individuals had shorter hospital stays, fewer negative comments in nurses' notes, and fewer intakes of analgesics if their bedside windows overlooked trees rather than a brick wall (Ulrich, 1984). This study extends earlier studies documenting the health benefits of passively viewing plants. This study confirmed that presenting indoor plants in hospital room during recovery period had a positive influence linking directly to health outcomes of surgical patients. In comparison with the control, the patients exposed to indoor plants during recovery in hospital rooms had significantly enhanced physiological responses, lower ratings of pain, anxiety and fatigue, and more positive feelings and higher satisfaction about their hospital rooms.

Watching and tending plants has therapeutic value for patients. A plant environment may play a far more significant role in the recovery from surgery and quality of life of patients in a hospital than has previously been recognized. If properly maintained, indoor plants can provide a great opportunity for patients to experience nature in all seasons when outdoor scenery could not provide this benefit. Further, they can provide meaningful therapeutic contact for, especially, patients spend much of their time indoors while recovering from painful surgery.

Findings of this study may be not applied to the immediate environments of severely immunocompromised and intensive care unit patients. However, the evidence is sufficient to support a recommendation that there is no reason to prohibit plants and flowers from a general hospital ward. This nonpharmacological and noninvasive approach is medically beneficial and clearly cost-effective. Outcomes of this study will substantially affect patients' and hospital administrators' decisions that indoor plant intervention can foster improved medical outcomes, increase satisfaction with providers, and be acceptably cost effective as compared to other alternatives.

Acknowledgements

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Figures and Tables

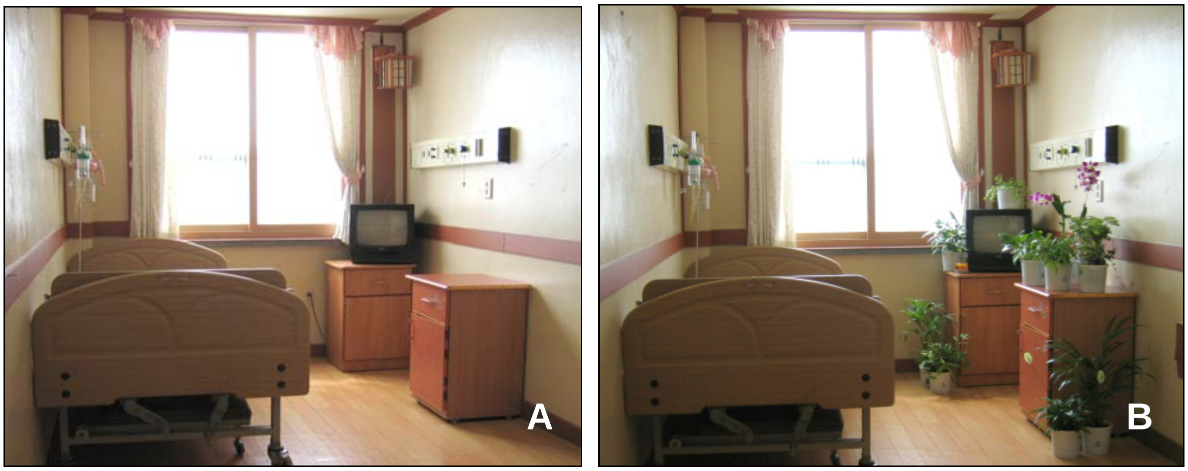

Fig. 3.1. Photographs of the two treatments: (A) no plants and (B) foliage and flowering plants.

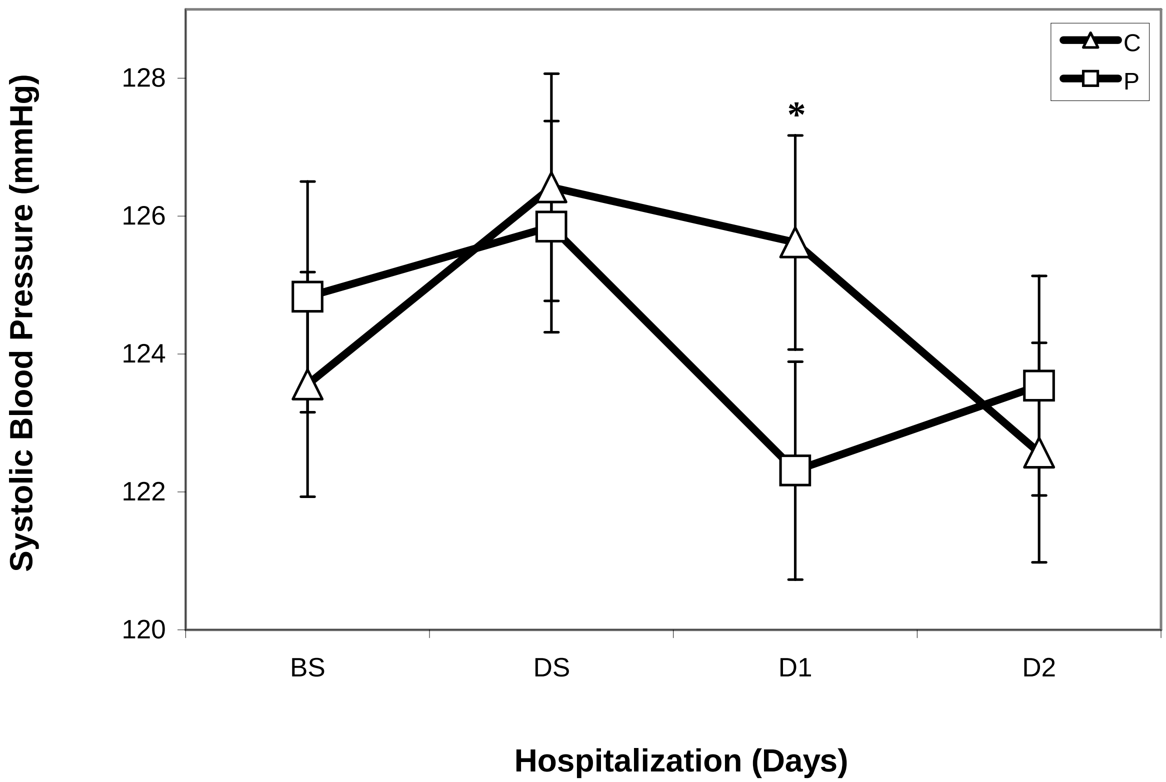

Fig. 3.2. Comparisons of control (C) and plant (P) groups in systolic blood pressure. Error bars label S.E. of estimates. BS, DS, D1, and D2 indicate before surgery, the day of surgery, first day after surgery, and second day after surgery, respectively**.**

* Control vs. plants, $P < 0.05$.

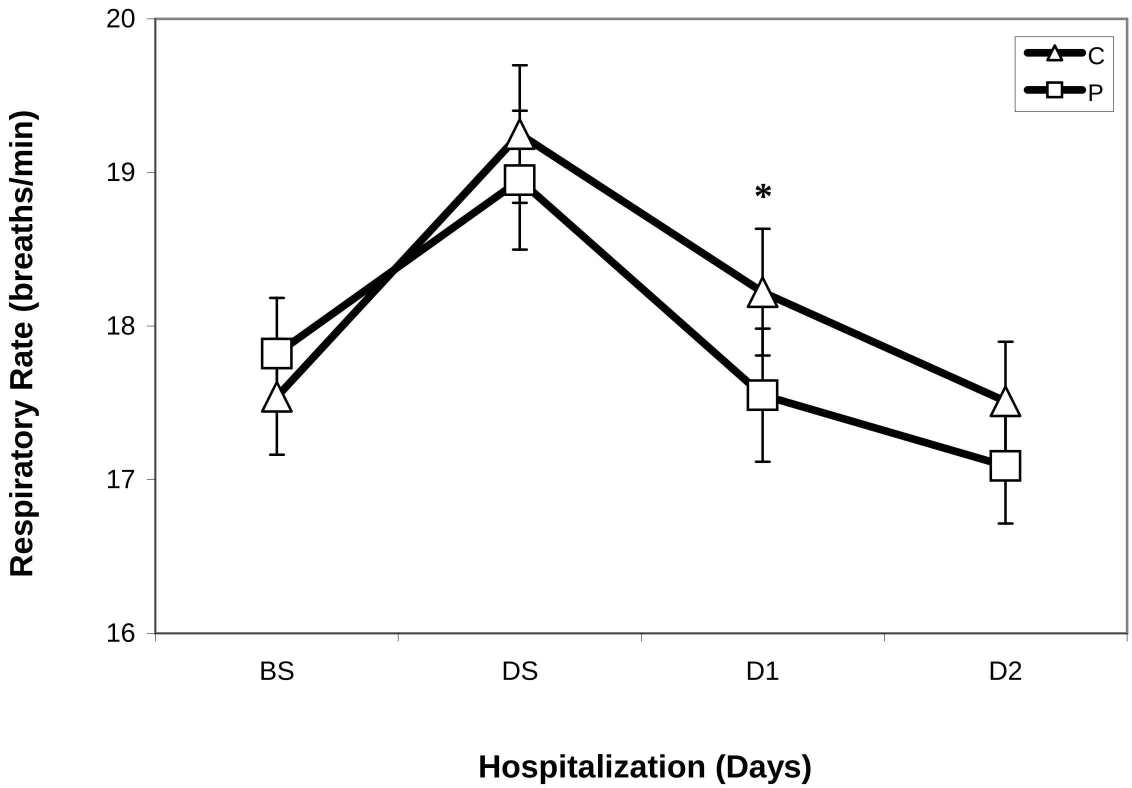

Fig. 3.3. Comparisons of control (C) and plant (P) groups in respiratory rate. Error bars label S.E. of estimates. BS, DS, D1, and D2 indicate before surgery, the day of surgery, first day after surgery, and second day after surgery, respectively.

* Control vs. plants, $P < 0.05$.

Table 3.1. Mean and standard deviation (SD) of control (C) and plant (P) groups in the rated for pain intensity, pain distress, anxiety, fatigue, and STAI-Y1.

	Pain Intensity[z]		Pain Distress[z]		Anxiety[z]		Fatigue[z]		STAI-Y1[y]	
	C	P	C	P	C	P	C	P	C	P
BS	57.84 (10.62)	54.58 (14.18)	57.10 (8.79)	53.95 (13.55)	71.06 (17.24)	67.41 (18.39)	40.05 (13.14)	37.33 (15.42)	46.96 (4.77)	45.74 (4.86)
DS	87.58 (8.61)	84.77 (7.83)	84.84 (7.82)	81.50 (8.69)	46.73 (15.10)	38.86* (15.98)	77.46 (12.58)	73.42 (12.81)	42.11 (3.83)	39.97* (4.76)
D1	69.12 (14.08)	62.05* (13.88)	65.28 (14.45)	59.25* (13.28)	20.27 (11.08)	14.96* (9.44)	41.97 (17.48)	33.87* (20.75)	35.36 (4.37)	32.81* (4.69)
D2	53.88 (11.81)	47.79* (12.01)	47.53 (14.26)	43.07 (13.61)	7.39 (7.24)	4.02* (4.91)	15.01 (14.78)	11.60 (11.88)	28.33 (3.40)	26.65* (3.30)

BS = before surgery; DS = the day of surgery; D1 = first day after surgery; D2 = second day after surgery.

[z]Pain intensity: 0 = no pain, 100 = pain as bad as it could be; Pain distress: 0 = comfortable, 100 = excruciating; Anxiety: 0 = complete relaxation, 100 = the worst feelings of anxiety; Fatigue: 0 = no fatigue, 100 = worst fatigue.

[y]Twenty items (ten anxiety-present items and ten anxiety-absent items) were given a weighted score of 1 to 4 (1 = not at all, 2 = somewhat, 3 = moderately, 4 = very much). A rating of 4 indicates the presence of a high level of anxiety for ten anxiety-present items and the anxiety-absent items for which the scoring weights are reversed. Scores are ranging from 20 to 80. A lower value indicates less anxiety.

* $P < 0.05$ (compared with control).

Table 3.2. Mean changes in the 13 items of the Environmental Assessment Scale (EAS)[z] self-rated by patients with hemorrhoidectomy (45 patients per group) before surgery and at the last day of hospitalization, in responses to viewing 'foliage and flowering plants' and 'no plants' during recovery.

Items	Control Group			Plant Group		
	Pre	Post	Post-Pre[y]	Pre	Post	Post-Pre[y]
Satisfying-Annoying	6.22	6.22	-0.00	6.24	7.05	0.81*
Clean-Dirty	4.93	4.69	-0.24	5.05	5.29	0.24*
Relaxing-Stressing	5.36	5.17	-0.19	5.23	5.96	0.73**
Comfortable-Uncomfortable	5.31	5.14	-0.17	5.28	5.85	0.57*
Colorful-Drab	4.88	4.91	0.03	4.94	6.71	1.77**
Happy-Sad	4.90	4.85	-0.05	4.94	5.63	0.69*
Pleasant smell-Unpleasant smell	4.67	4.46	-0.21	4.82	5.04	0.22
Bright-Dull	6.87	7.21	0.34	6.82	7.15	0.33
Spacious-Crowded	5.11	5.23	0.12	5.20	5.22	0.02
Calming-Irritating	5.26	5.32	0.06	5.46	6.51	1.05**
Warm-Cool	4.93	4.97	0.04	5.02	5.06	0.04
Attractive-Unattractive	4.52	4.51	-0.01	4.69	5.40	0.71*
Quiet-Noisy	6.12	6.19	0.07	5.98	6.04	0.06

[z]EAS (Rohles and Milliken, 1981) is based on a nine-point scale (1 = the least desirable, 9 = the most desirable).
[y]Differences in EAS scores of pre-test (self-rated before surgery) and post-test (self-rated at the last day of hospitalization), were computed.
* $P < 0.05$ (compared with control).
** $P < 0.01$ (compared with control).

APPENDICES

Appendix A. Detailed Information on Materials and Methods

Appendix – A

DEMOGRAPHIC QUESTIONNAIRE

(Gyeongsang National University Hospital)

등록번호

이 름

주민등록 번 호

과 명

간호정보조사지(성인)

일반정보

입 원 일 ________ 년 ________ 월 ________ 일 ________ 시

정보제공자 ____________ 작성간호사 ____________

직 업 ____________ 교 육 정 도 ____________

종 교 ____________ 전 화 번 호 ____________

현 주 소 ____________

흡 연 양 ________ 갑/일 기간 ______ 년

음 주 종류 ____________ 양 ______ 병/회 횟수 ______ 회/월 기간 ______ 년

가계도 및 가족병력

입원과 관련된 정보 진단명 ____________

입원경로 □ 외래 □ 응급실 □ 기타 ____________

입원방법 □ 도보 □ 휠체어 □ 눕는차 □ 기타 ____________

입원동기 주증상 ____________ 발병일 ____________

과거병력 □ 고혈압 □ 당뇨 □ 결핵 □ 기타 ____________

수 술 명 ____________ 알레르기 □ 없음 □ 있음 ____________

최근투약상태 ____________

병에 대한 인식 ____________

신체검진

전반적 상태

기 형 □ 없음 □ 있음 부위 ____________

동 통 □ 없음 □ 있음 부위 ____________ (둔함, 쑤심, 퍼짐, 예리함, 찌르는듯함, 기타)

식 욕 □ 좋음 □ 보통 □ 나쁨 체중변화 □ 없음 □ 있음 ____________

수면상태 수면시간 ________ 시간/일, 수면장애 ________ 수면을 돕는법 ____________

대 변 횟수 _____ 회/( )일 색깔 ________ □ 설사 □ 변비 □ 동통 □ 기타

소 변 횟수 _____ 회/( )일 양 ________ 색깔 ________ 냄새 ____________

□ 빈뇨 □ 핍뇨 □ 혈뇨 □ 긴급뇨의 □ 실금 □ 작열감 □ 배뇨곤란

활동상태 □ 자유로움 □ 자유롭지 못함

경 상 대 학 교 병 원 GNUH Form 90-1

피　　부 피부상태 ☐ 정상 ☐ 비정상 부위 ________________
(발진, 물집, 흉터, 상처, 반점, 욕창, 발한, 건조, 소양감, 불결함)
피부색깔 ☐ 정상 ☐ 비정상(창백, 홍조, 청색증, 황달) 부위 ________

소화기계 소화기장애 ☐ 없음
☐ 있음 (연하곤란, 오심, 구토, 토혈, 소화장애, 복부팽만, 복부동통, 액변, 인공장루)

순환기계 순환기장애 ☐ 없음
☐ 있음 (심계항진, 흉통, 청색증, 호흡곤란, 식은땀, 부정맥, 심잡음)
부　　종 ☐ 없음 ☐ 있음 부위 (전신, 사지, 상지, 하지, 얼굴, 안검, 기타)
요　　흔 ☐ 없음 ☐ 있음

호흡기계 호흡기장애 ☐ 없음
☐ 있음 (호흡곤란, 가래, 기침, 폐잡음, 청색증, 객혈, 이상호흡음, 기관절개관)

신 경 계 동공크기 (대칭, 비대칭) 빛반사 좌 (반응, 무반응), 우 (반응, 무반응)
시력장애 ☐ 없음 ☐ 있음 (좌/우) ________________
청력장애 ☐ 없음 ☐ 있음 (좌/우 : 청력저하, 이명, 청각상실, 기타)
신경근육 ☐ 이상없음 ☐ 무감각 / 저림 ☐ 동통 부위 ________
마　　비 ☐ 없음 ☐ 있음 부위 (상지 : 좌/우, 하지 : 좌/우)

의식상태 지 남 력 사람 (있음/없음) 시간 (있음/없음) 장소 (있음/없음)
의　　식 ☐ 명료 ☐ 혼돈 ☐ 반의식 ☐ 무의식 (통증에 반응 : 있음/없음)
의사소통 ☐ 원만함 ☐ 곤란함 ☐ 불가능함

정서상태 ☐ 안정 ☐ 불안 ☐ 슬픔 ☐ 분노 ☐ 우울 ☐ 흥분 ☐ 안절부절 ☐ 기타

보조기구 ☐ 없음
☐ 있음 (의치, 안경, 콘택트렌즈, 보청기, 보조기, 의안, 가발, 목발, 지팡이, pace maker)

입원시 간호 및 교육내용

☐ 입원시 준비물품
☐ 병실내 시설 안내
☐ 침대 ☐ 침상식탁 ☐ 침상등 ☐ 전화 ☐ TV ☐ 샤워실 ☐ 간호사호출기
☐ 병원시설 안내
☐ 배선실 ☐ 은행 ☐ 우편함 ☐ 매점 ☐ 식당 ☐ 공중전화
☐ 가스, 전열기구 사용금지 및 화재방지
☐ 귀중품 관리 및 도난방지
☐ 낙상방지
☐ 보호자 면회 및 식사시간
☐ 지정진료, 진단서 발급, 의사회진시간

환자(보호자) 서명 ________________

DEMOGRAPHIC QUESTIONNAIRE

(Bando Hospital)

입원 환자 간호력

환 자 성 명	과 별 / 병 실	성 별 / 나 이	작성자성명

1. 일반정보

입원경로 ☐ 외래 ☐ 응급실
가족사항 ☐ 미혼 ☐ 기혼
직업 __________ 종교 __________
기호식품 ☐ 흡연 ☐ 음주

2. 신체정보

체중 __________ 신장 __________
마지막 배변 ______ 월 ______ 일
마지막 월경 ______ 년 ______ 월 ______ 일
신체장애 ☐ 무 ☐ 유 렌즈 ☐ 무 ☐ 유
보 청 기 ☐ 무 ☐ 유 의치 ☐ 무 ☐ 유
특이체질 ☐ 무 ☐ 유 ☐ 페니실린
☐ 아스피린
☐ 마이신
☐ 기 타 __________

3. 입원시 상태

의식정도 ☐ 정상 ☐ 졸린상태 ☐ 질문에만 반응
☐ 통증에만 반응 ☐ 통증에도 반응 없음

4. 병 력

입원경력 ☐ 무 ☐ 유 (시기 ______ , 병명 ______ , 장소 ______)
수술경력 ☐ 무 ☐ 유 (시기 ______ , 병명 ______ , 장소 ______)
과거경력 ☐ 무 ☐ 유 ☐ 갑상선
☐ 심장 폐질환
☐ 기타
가 족 력 ☐ 결핵, ☐ 당뇨, ☐ 간질, ☐ 고혈압

5. 현재 증상

____
____
____

의료법인 반도병원 NO. H-41

KANSAS STATE UNIVERSITY
INFORMED CONSENT TEMPLATE

PROJECT TITLE: Post-operative patient recovery responses in a hospital room

PRINCIPAL INVESTIGATOR: CO-INVESTIGATOR(S): Dr. Richard H. Mattson : Seong-Hyun Park

CONTACT AND PHONE FOR ANY PROBLEMS/QUESTIONS: Dr. Richard H. Mattson
(785) 532-1420
rmattson@oznet.ksu.edu

IRB CHAIR CONTACT/PHONE INFORMATION: * Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 1 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.
* Jerry Jaax, Associate Vice Provost for Research Compliance and University Veterinarian, 1 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

SPONSOR OF PROJECT: Not Applicable

PURPOSE OF THE RESEARCH: To examine the impact of the hospital room environment on stress and recovery, this research will measure your physiological responses and feelings to stress and environment.

PROCEDURES OR METHODS TO BE USED: You will be asked to rate how your surgical experience affects your feelings using ratings of pain, anxiety and fatigue and standard questionnaires on arrival at the pre-operative room, on arrival in the post-operative recovery room, and during the recovery period. At the last day of hospitalization, you will be asked to answer a questionnaire related to your satisfaction about the hospital room environment.

ALTERNATIVE PROCEDURES OR TREATMENTS, IF ANY, THAT MIGHT BE ADVANTAGEOUS TO SUBJECT: N/A

LENGTH OF STUDY: Post-operative stays in a hosptial of four to seven days

RISK ANTICIPATED: There are no foreseeable risks to you.

BENEFITS ANTICIPATED: By documenting the impact of hospital room environments on human health benefits, this research may help future hospital patients to decrease their stress and to enhance faster recovery.

EXTENT OF CONFIDENTIALITY: Your name will not be associated with the research. You will be assigned a number for data analysis use. All information collected will remian confidential.

IS COMPENSATION OR MEDICAL TREATMENT AVAILABLE IF INJURY OCCURS: N/A

PARENTAL APPROVAL FOR MINORS: Not Applicable

TERMS OF PARTICIPATION: I understand this project is for research and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and

stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.
I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.
(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant.)

Participant Name: ____

Participant Signature: ______________________________________ **Date:** __________________

Witness to Signature: (project staff) __________________________ **Date:** __________________

MEASUREMENTS OF PAIN, ANXIETY AND FATIGUE

(ENGLISH VERSION)

INSTRUCTIONS: Please indicate on the line below the number between 0 and 100 that best describe your **pain intensity, pain distress, anxiety and fatigue** *at this moment*. There are no right or wrong answers. A zero (0) would mean "no symptoms", and a one hundred (100) would mean "worst symptoms."

PAIN INTENSITY: 0 = no pain, 100 = pain as bad as it could be

Please write only one number ____________

PAIN DISTRESS: 0 = comfortable, 100 = excruciating

Please write only one number ____________

ANXIETY: 0 = complete relaxation, 100 = the worst feelings of anxiety

Please write only one number ____________

FATIGUE: 0 = no fatigue, 100 = worst fatigue

Please write only one number ____________

MEASUREMENTS OF PAIN, ANXIETY AND FATIGUE

(KOREAN VERSION)

통증, 불안, 피로 정도 자가측정지

지금, 이 순간 환자분이 느끼고 있는 통증 강도, 통증에 대한 스트레스 정도, 불안 정도, 그리고 피로 정도를 **0 에서 100 사이 숫자**로 표시해 주십시오.
정답은 없습니다. 0은 "증상이 없음"을 의미하고, 100은 "가장 심한 증상"을 의미합니다.

1. 현재 통증이 얼마나 심합니까?
(0 : 통증이 없다 ----------------- 100 : 통증이 매우 심하다)

한가지 숫자만 선택해서 써주십시오 ______________

2. 현재 통증에 대해 느끼는 스트레스 정도는 얼마나 됩니까?
(0 : 통증에 대한 스트레스가 없다 -------- 100 : 통증에 대한 스트레스가 매우 심하다)

한가지 숫자만 선택해서 써주십시오 ______________

3. 현재 불안 정도는 얼마나 됩니까?
(0 : 아주 편하다 ----------------- 100 : 불안정도가 매우 심하다)

한가지 숫자만 선택해서 써주십시오 ______________

4. 현재 피로함은 얼마나 됩니까?
(0 : 피로함을 전혀 느끼지 않는다 ------------ 100 : 매우 피로하다)

한가지 숫자만 선택해서 써주십시오 ______________

FIVE SAMPLE ITEMS FROM THE STATE-TRAIT ANXIETY INVENTORY FORM Y-1 (STAI-Y1)

(ENGLISH VERSION)

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-1

Please provide the following information:

Name: ____ Date: ________________

Age: ___________ Gender (*Circle*) M F

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm ……….………………………………………………	①	②	③	④
3. I am tense ……………………………………………….………..	①	②	③	④
12. I feel nervous ………………………………………………….	①	②	③	④
15. I am relaxed ……...………………………………...…………..	①	②	③	④
17. I am worried …..………………………………………….....	①	②	③	④

Published by Mind Garden, Inc., 1690 Woodside Rd, Suite 202, Redwood City, CA 94061

STAIP-AD Test Form Y

www.mindgarden.com

FIVE SAMPLE ITEMS FROM
THE STATE-TRAIT ANXIETY INVENTORY FORM Y-1 (STAI-Y1)

(KOREAN VERSION)

심리 검사 자가 진단지

Developed by Charles D. Spielberger

STAI Form Y-1

성명: ______________________ 날짜: ________________________________

다음 문항들은 사람들이 자신을 표현할 때 사용하고 있는 말들입니다. 각 항목을 읽으시고 여러분이 **현재, 지금 이 순간** 느끼고 있는 바를 가장 잘 나타내 주는 문항에 체크하시기 바랍니다. 정답은 없습니다. 한 문항에 너무 오랜 시간 머물지 마시고, 지금 느낌을 가장 잘 표현한 것에 답하시기 바랍니다.

①: 전혀 그렇지 않다
②: 그렇지 않은 편이다
③: 다소 그런 편이다
④: 아주 그렇다

1. 나는 마음이 차분하다 ······ ① ② ③ ④

3. 나는 긴장되어 있다 ······ ① ② ③ ④

12. 나는 짜증스럽다 ······ ① ② ③ ④

15. 내 마음은 긴장이 풀려 푸근하다 ······ ① ② ③ ④

17. 나는 걱정하고 있다 ······ ① ② ③ ④

mind garden

855 Oak Grove Avenue, Suite 215 Menlo Park, CA 94025
650-322-6300 fax 650-322-6398 www.mindgarden.com

Date: Sept. 26, 2006

To whom it may concern,

This letter is to grant permission for: Seong-Hyun Park
to use the following copyright material;

Instrument: *State Trait Anxiety Inventory for Adults*

Author: *Charles D. Spielberger*

Copyright: *1983 by Charles D. Spielberger*
for her/his thesis research.

In addition, five (5) sample items from the instrument may be reproduced for inclusion in a proposal or thesis.

The entire measure may not at any time be included or reproduced in other published material.

Sincerely,

Sandra Darrow
Customer Service

ENVIRONMENTAL ASSESSMENT SCALE

(ENGLISH VERSION)

Name: ____ **Date:** _______________

Age: ___________ **Sex: M** ____ **F** ____

INSTRUCTIONS: This questionnaire has pairs of adjectives that can be used to describe how the environment in this room feels to you. Look over the list of adjectives and place ONE checkmark (√) which comes closest to how you are feeling about your hospital room.

	Very closely	Quite closely	Somewhat closely	Only slightly	neutral	Only slightly	Somewhat closely	Quite closely	Very closely	
1. Satisfying room	____	____	____	____	____	____	____	____	____	**Annoying room**
2. Clean	____	____	____	____	____	____	____	____	____	**Dirty**
3. Relaxing	____	____	____	____	____	____	____	____	____	**Stressing**
4. Comfortable	____	____	____	____	____	____	____	____	____	**Uncomfortable**
5. Colorful	____	____	____	____	____	____	____	____	____	**Drab**
6. Happy	____	____	____	____	____	____	____	____	____	**Sad**
7. Pleasant smell	____	____	____	____	____	____	____	____	____	**Unpleasant smell**
8. Bright	____	____	____	____	____	____	____	____	____	**Dull**
9. Spacious	____	____	____	____	____	____	____	____	____	**Crowded**
10. Calming	____	____	____	____	____	____	____	____	____	**Irritating**
11. Warm	____	____	____	____	____	____	____	____	____	**Cool**
12. Attractive	____	____	____	____	____	____	____	____	____	**Unattractive**
13. Quiet	____	____	____	____	____	____	____	____	____	**Noisy**

ENVIRONMENTAL ASSESSMENT SCALE

(KOREAN VERSION)

병실환경 자가 진단지

성명 : ______________________ 날짜: __________________________________

다음 문항들은 병실환경을 표현할 때 사용할 수 있는 말들입니다. 여러분이 입원하고 계시는 병실에 대해 느끼고 있는 바를 가장 잘 나타내주는 문항에 √표 하시기 바랍니다.

⓪ : 이렇지도 저렇지도 않다
① : 아주 조금 그렇다
② : 다소 그렇다
③ : 제법 그렇다
④ : 아주 매우 그렇다

현재 입원 중인…

1. 병실환경에 만족한다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 불만이 많다

2. 병실환경이 깨끗하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 더럽다

3. 병실환경이 안락하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 스트레스를 준다

4. 병실환경이 편안하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 불편하다

5. 병실에 색이 다양하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 색이 단조롭다

6. 병실환경이 나를 기쁘게 한다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 나를 슬프게 한다

7. 병실에 기분 좋은 냄새가 난다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 불쾌한 냄새가 난다

8. 병실환경이 환하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 우중충하다

9. 병실이 넓다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 좁다

10. 병실환경이 평온하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 짜증난다

11. 병실이 덥다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 춥다

12. 병실환경이 지루하지 않다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 지루하다

13. 병실이 조용하다 ④ - ③ - ② - ① - ⓿ - ① - ② - ③ - ④ 시끄럽다

SELF-EVALUATION QUESTIONNAIRE

PATIENT'S SATISFACTION ABOUT THE HOSPITAL ROOM (ENGLISH VERSION)

This questionnaire is designed to help your hospital better understand how your hospital room environment is important on your recovery. Your participation and opinions are greatly appreciated and will impact ongoing improvement at hospital.

1. Please list three physical features you liked about your hospital room

    - ____________________
    - ____________________
    - ____________________

2. Please list three physical features you did not like about your hospital room

    - ____________________
    - ____________________
    - ____________________

3. Would you use this type of patient room in the recovery phase of any future hospitalization?

    Yes (   )

    No (   )

4. Comments:

SELF-EVALUATION QUESTIONNAIRE

PATIENT'S SATISFACTION ABOUT THE HOSPITAL ROOM (KOREAN VERSION)

병실환경 만족 정도 질문지

다음은 앞으로 병원을 이용하실 환자분들께 보다 나은 병실환경을 제공하기 위해 드리는 질문입니다. 질문을 잘 읽으시고 본인의 의견을 적어주십시오.
참여해주셔서 감사합니다.

1. 환자분께서 입원기간 동안 머무신 병실 내부환경을 고려할 때 어떤 점이 가장 마음에 드셨습니까? 3가지를 적어주세요.

- ______________________________
- ______________________________
- ______________________________

2. 환자분께서 입원기간 동안 머무신 병실 내부환경을 고려할 때 어떤 점이 가장 마음에 들지 않으셨습니까? 3가지를 적어주세요.

- ______________________________
- ______________________________
- ______________________________

3. 차후 병원에 입원해야 할 경우가 생긴다면, 지금 머무신 병실과 유사한 병실환경을 다시 이용하시겠습니까?

   네 ( )
   아니오 ( )

4. 병실에 머무시는 동안 느꼈던 점이나, 저희 병원에 제안하고 싶으신 점이 있으시다면 적어주세요. (뒷장을 이용하셔도 좋습니다)

Fig. A.1. Fourth floor plan of Gyeongsang National University Hospital. Rooms 4102 to 4109 were used for the research with thyroidectomy patients.

Fig. A.2. Fourth floor plan of Bando Hospital. Rooms 401 to 411 (yellow-colored) were used for the research with appendectomy patients.

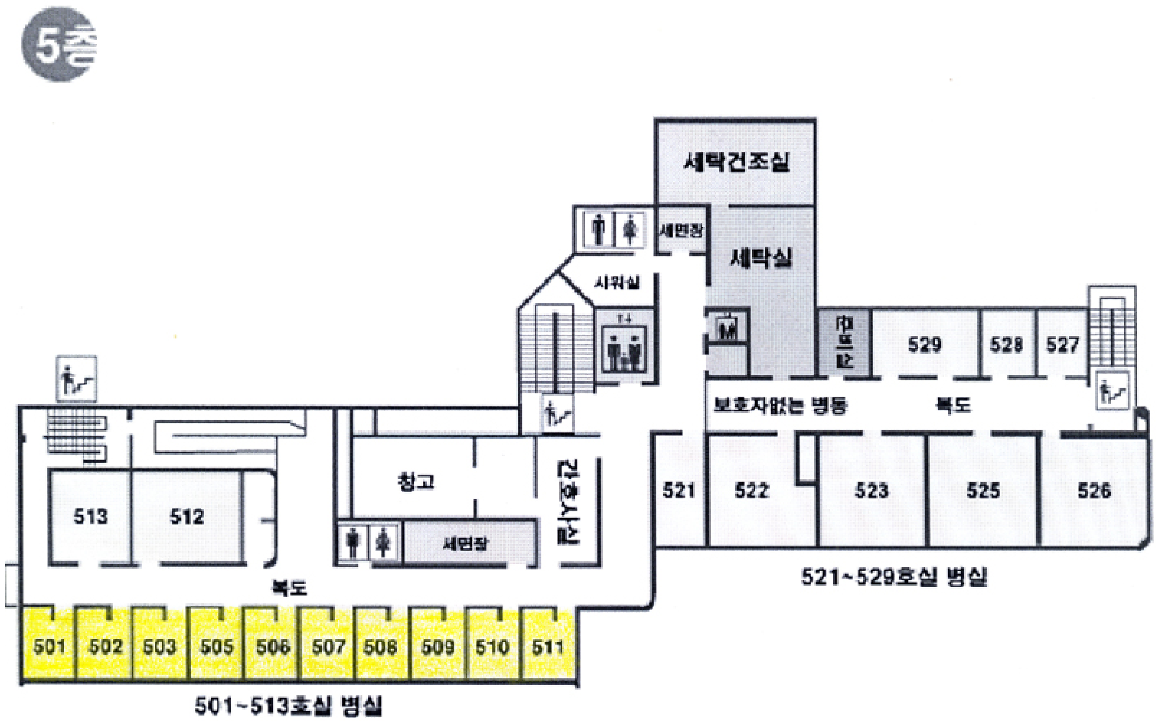

Fig. A.3. Fifth floor plan of Bando Hospital. Rooms 501 to 511 (yellow-colored) were used for the research with hemorrhoidectomy patients.

Appendix B. Additional Results

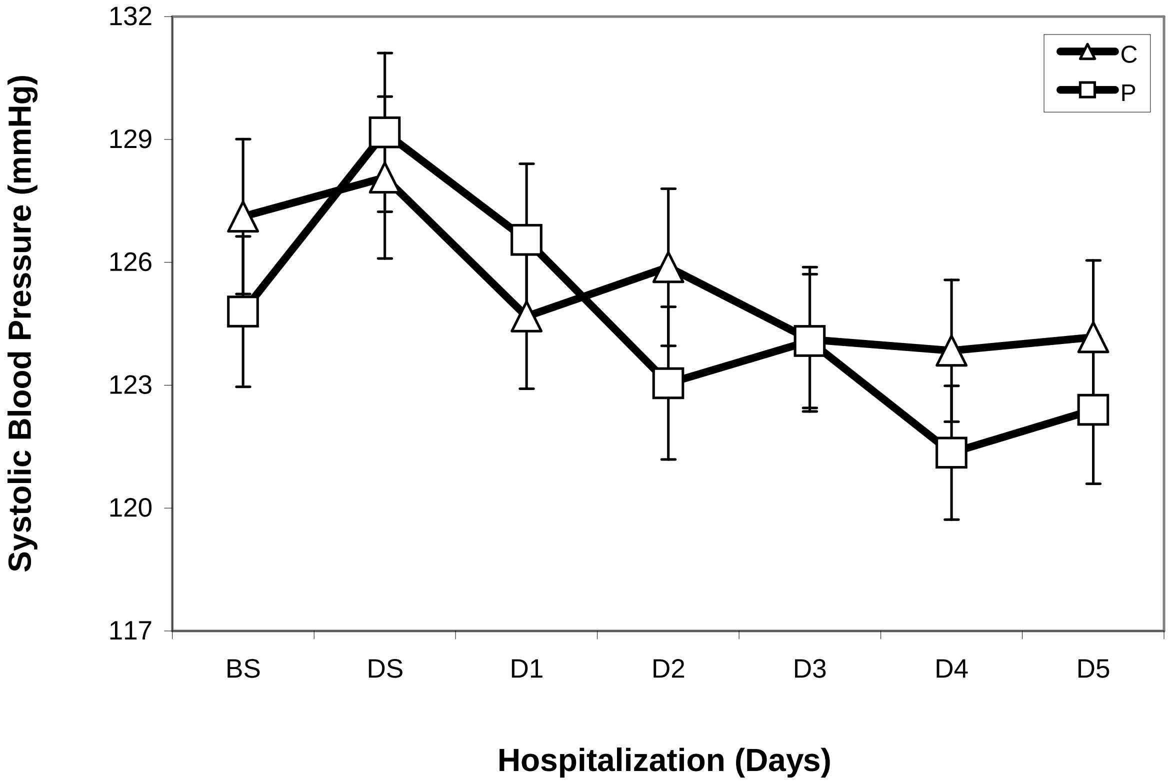

Fig. B.1. Comparisons of control (C) and plant (P) groups in systolic blood pressure of patients with thyroidectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, D3, D4, and D5 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, third day after surgery, fourth day after surgery, and fifth day after surgery, respectively.

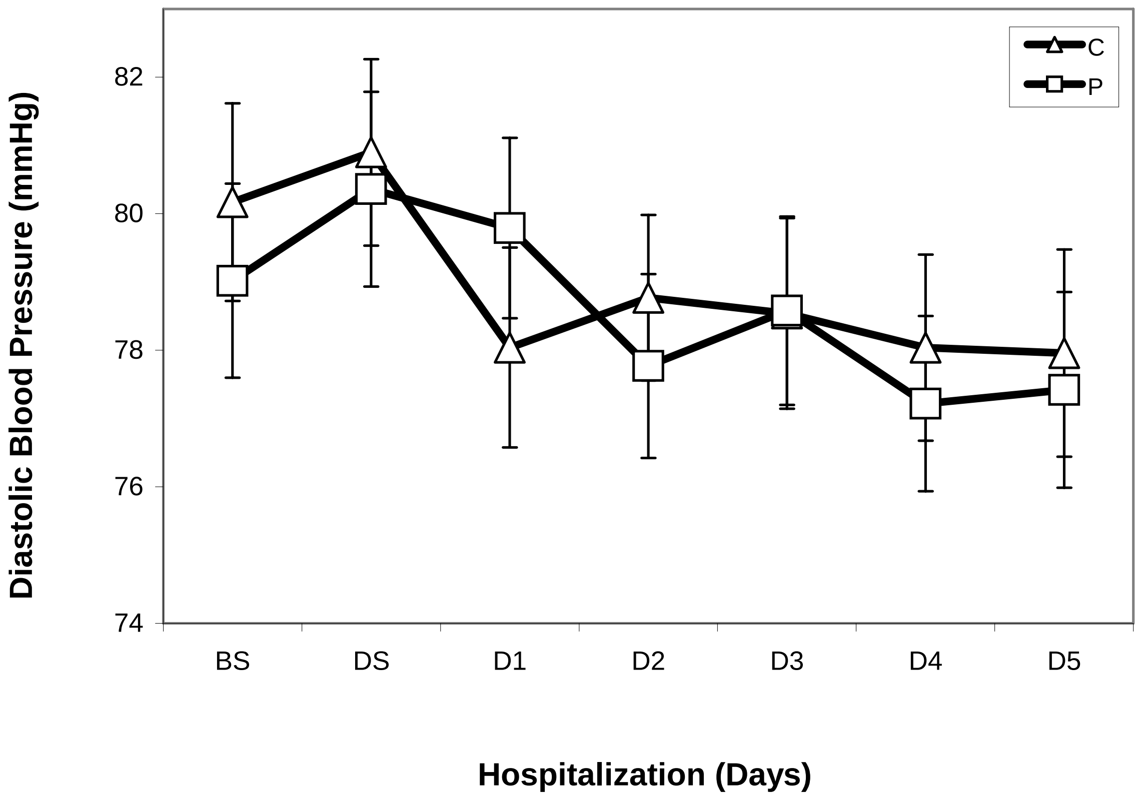

Fig. B.2. Comparisons of control (C) and plant (P) groups in diastolic blood pressure of patients with thyroidectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, D3, D4, and D5 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, third day after surgery, fourth day after surgery, and fifth day after surgery, respectively.

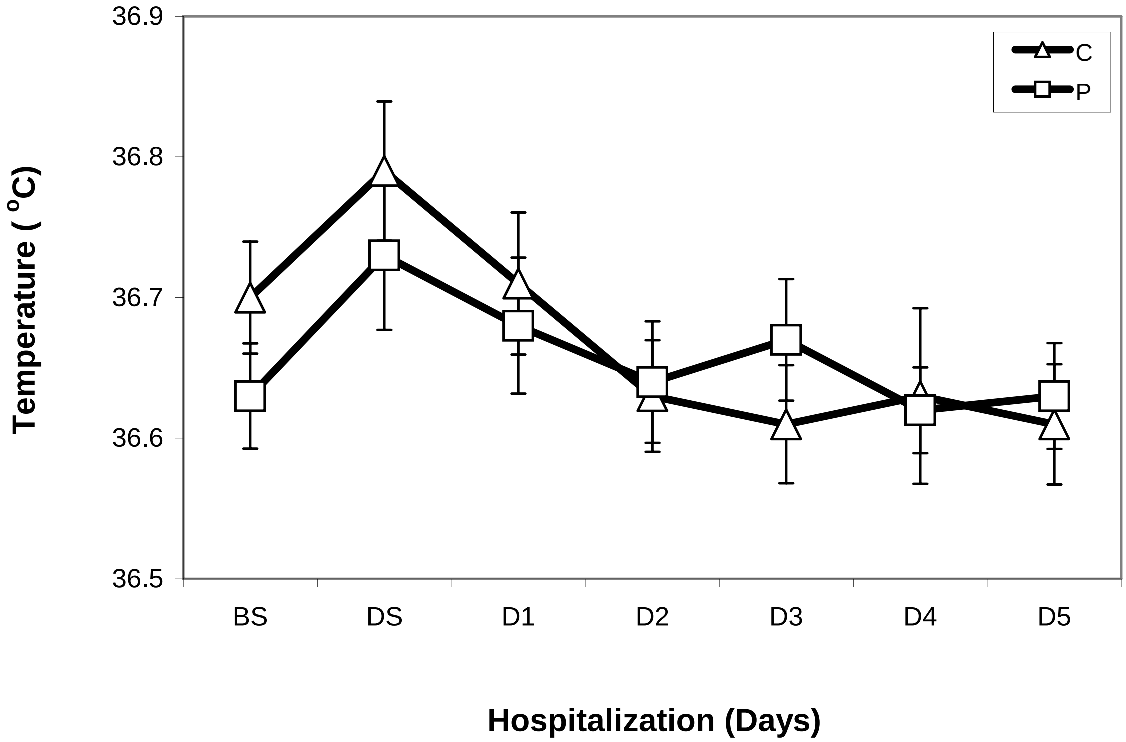

Fig. B.3. Comparisons of control (C) and plant (P) groups in temperature of patients with thyroidectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, D3, D4, and D5 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, third day after surgery, fourth day after surgery, and fifth day after surgery, respectively.

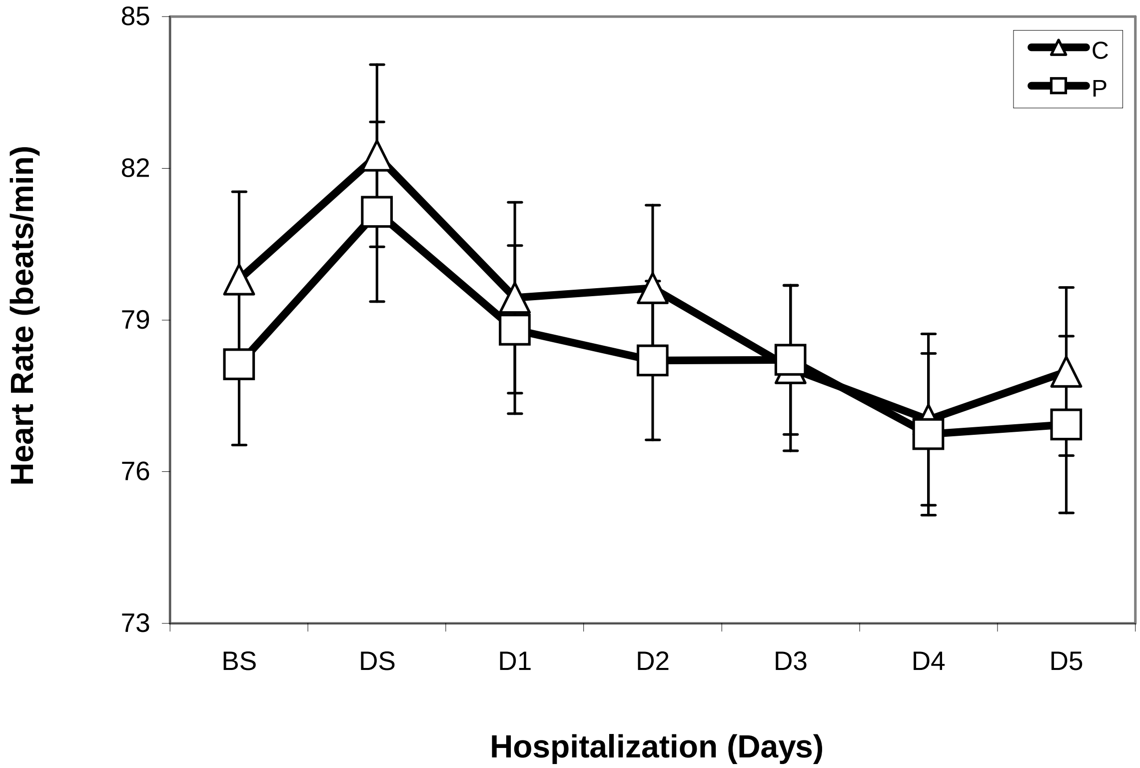

Fig. B.4. Comparisons of control (C) and plant (P) groups in heart rate of patients with thyroidectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, D3, D4, and D5 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, third day after surgery, fourth day after surgery, and fifth day after surgery, respectively.

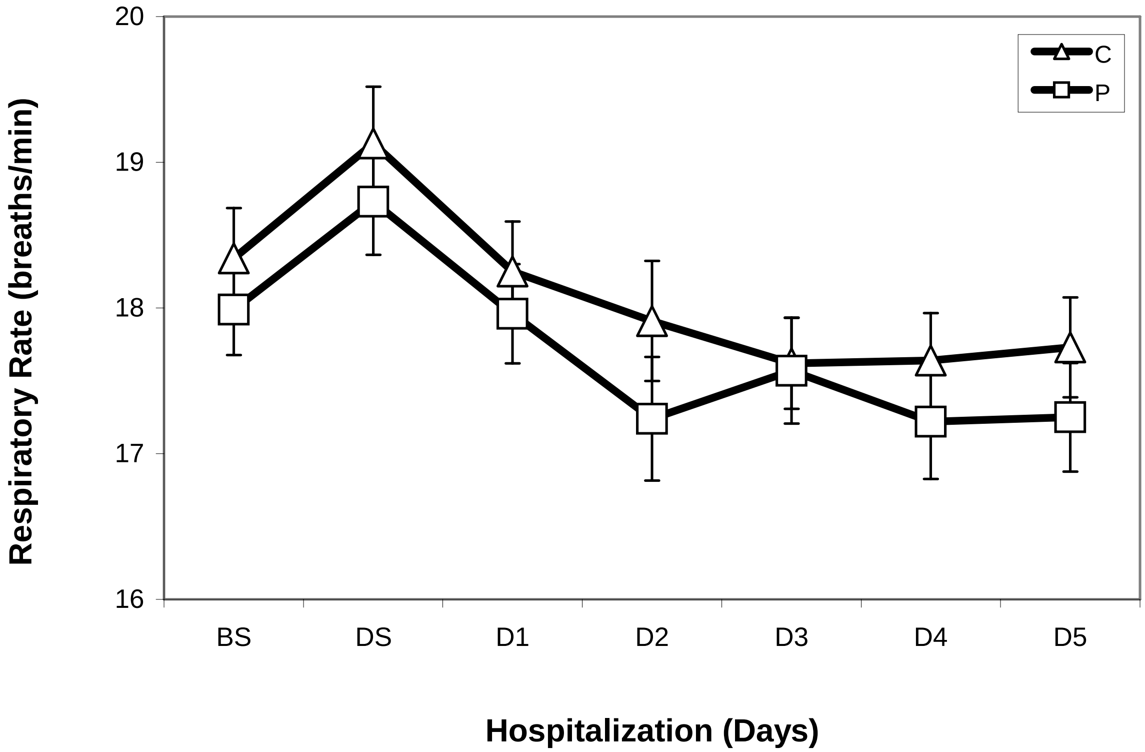

Fig. B.5. Comparisons of control (C) and plant (P) groups in respiratory rate of patients with thyroidectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, D3, D4, and D5 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, third day after surgery, fourth day after surgery, and fifth day after surgery, respectively.

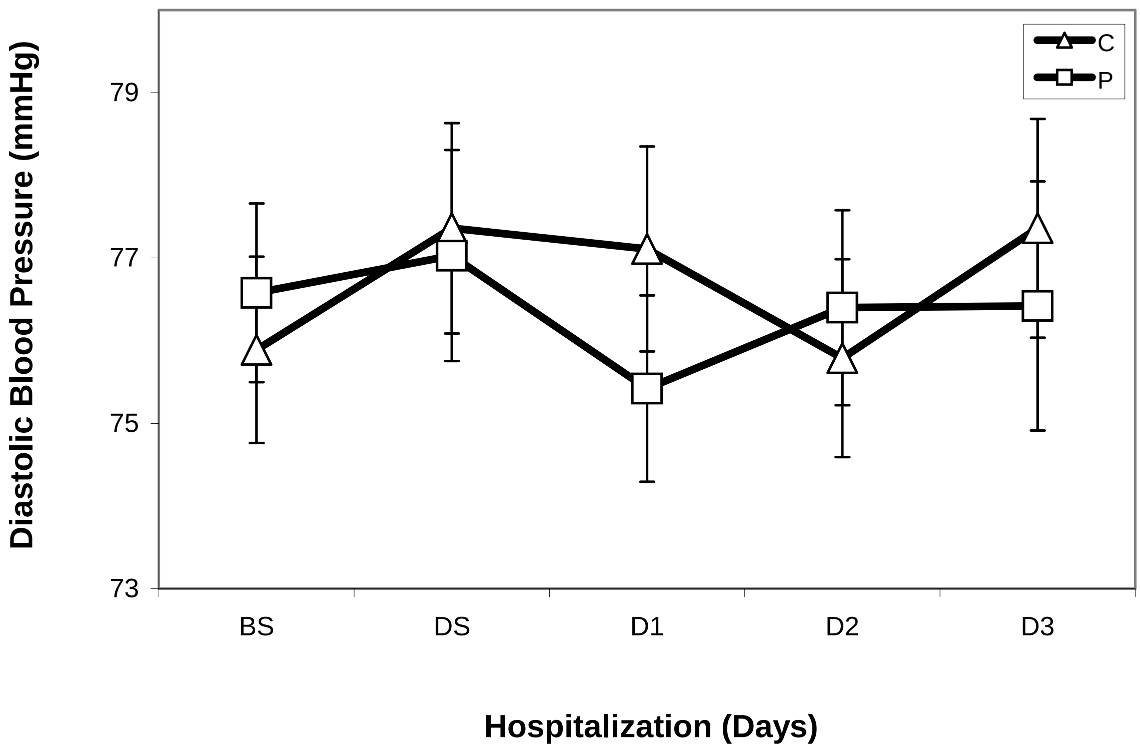

Fig. B.6. Comparisons of control (C) and plant (P) groups in diastolic blood pressure of patients with appendectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, and D3 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively.

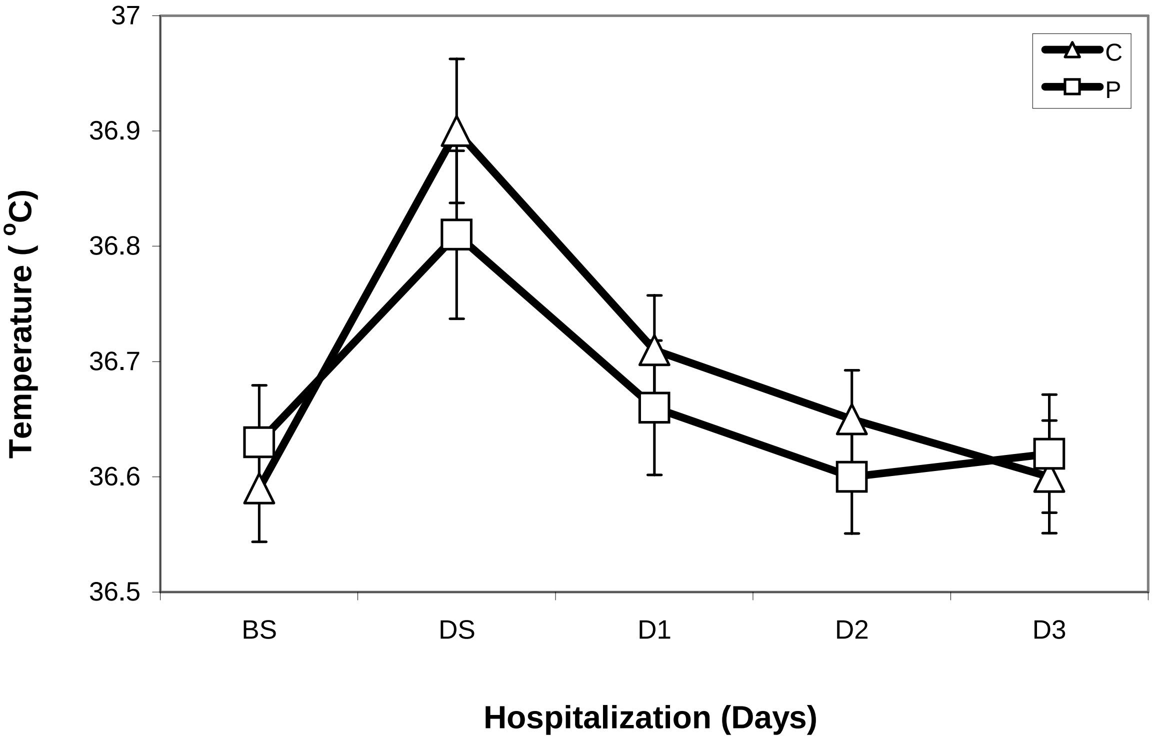

Fig. B.7. Comparisons of control (C) and plant (P) groups in temperature of patients with appendectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, and D3 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively.

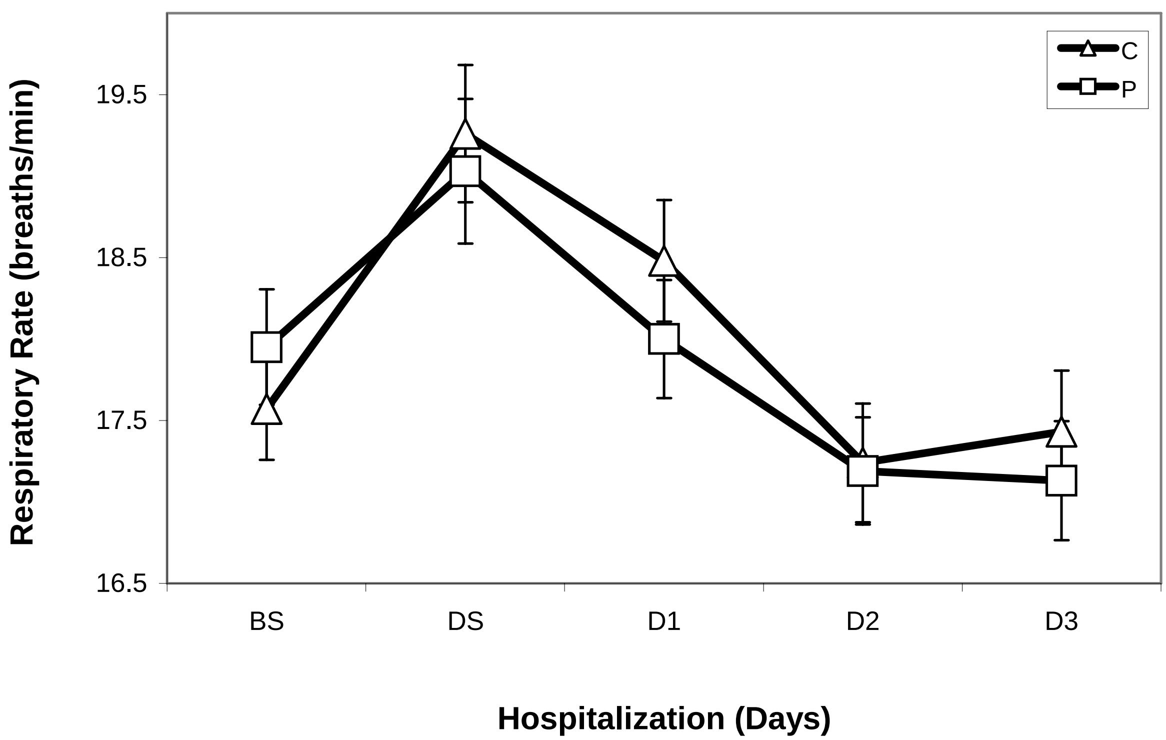

Fig. B.8. Comparisons of control (C) and plant (P) groups in respiratory rate of patients with appendectomy. Error bars label S.E. of estimates. BS, DS, D1, D2, and D3 indicate before surgery, the day of surgery, first day after surgery, second day after surgery, and third day after surgery, respectively.

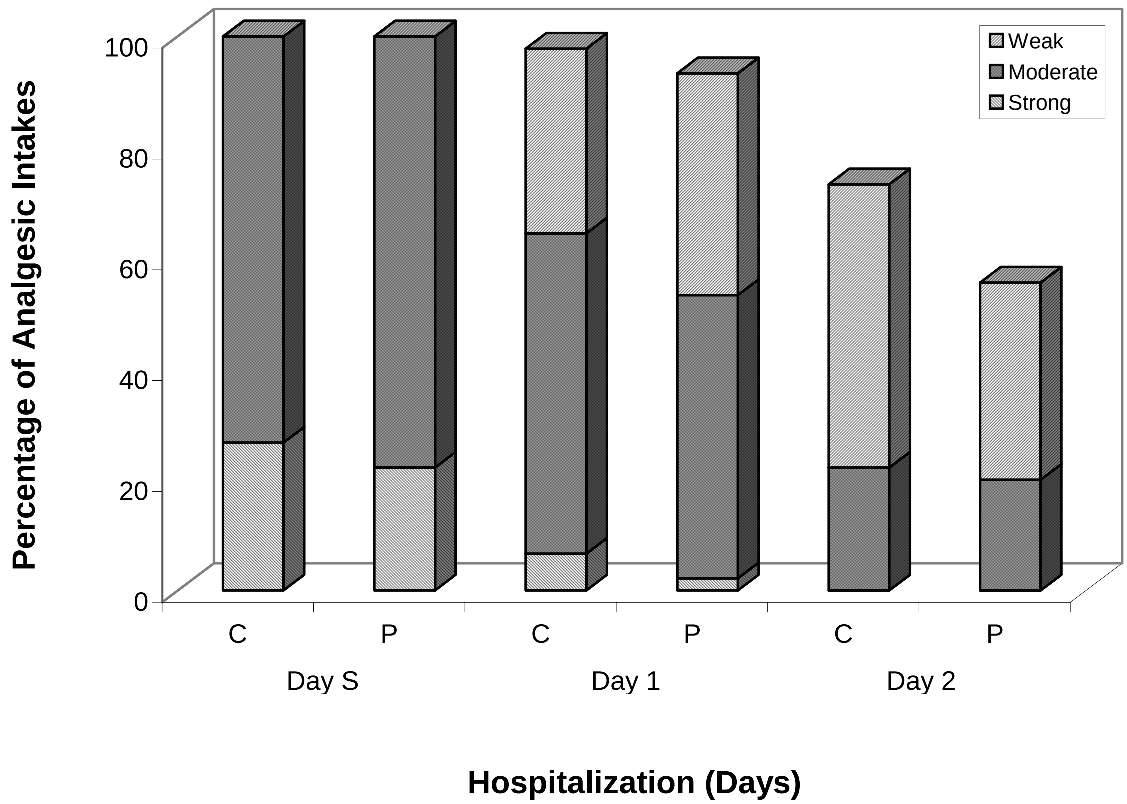

Fig. B.9. Comparisons of control (C) and plant (P) groups in postoperative analgesic intakes of patients with hemorrhoidectomy. Day S, Day 1, and Day 2 indicate the day of surgery, first day after surgery, and second day after surgery, respectively.

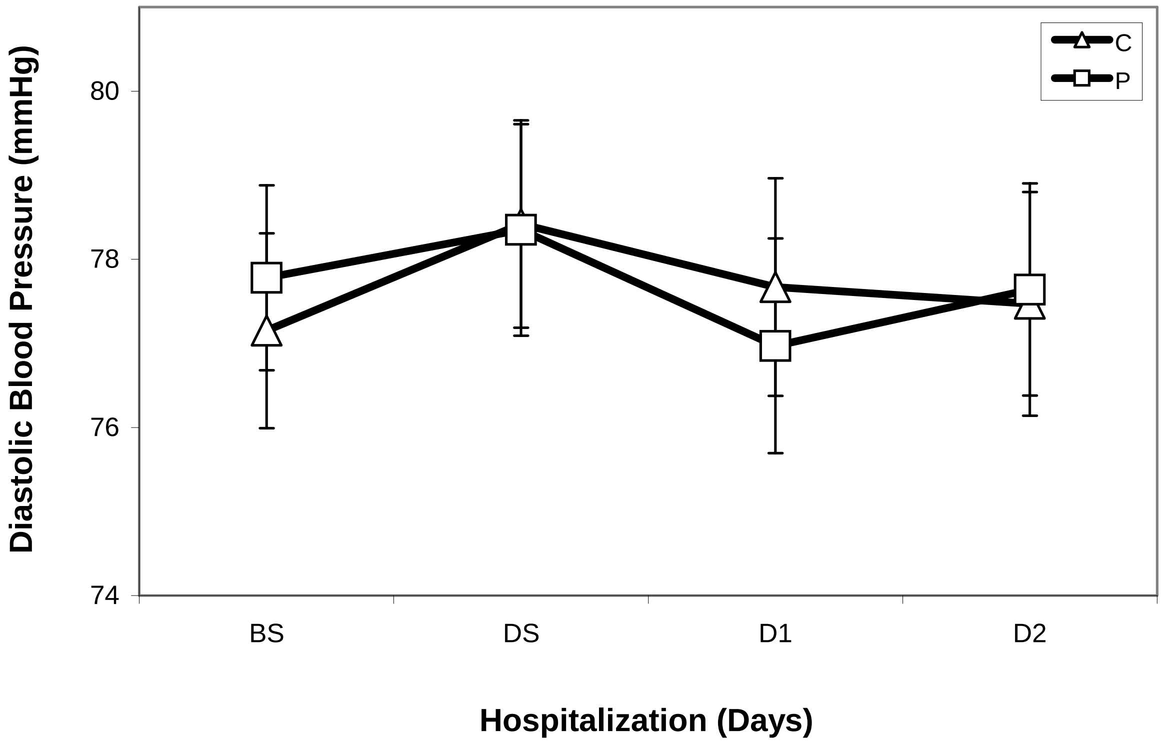

Fig. B.10. Comparisons of control (C) and plant (P) groups in diastolic blood pressure of patients with hemorrhoidectomy. Error bars label S.E. of estimates. BS, DS, D1, and D2 indicate before surgery, the day of surgery, first day after surgery, and second day after surgery, respectively.

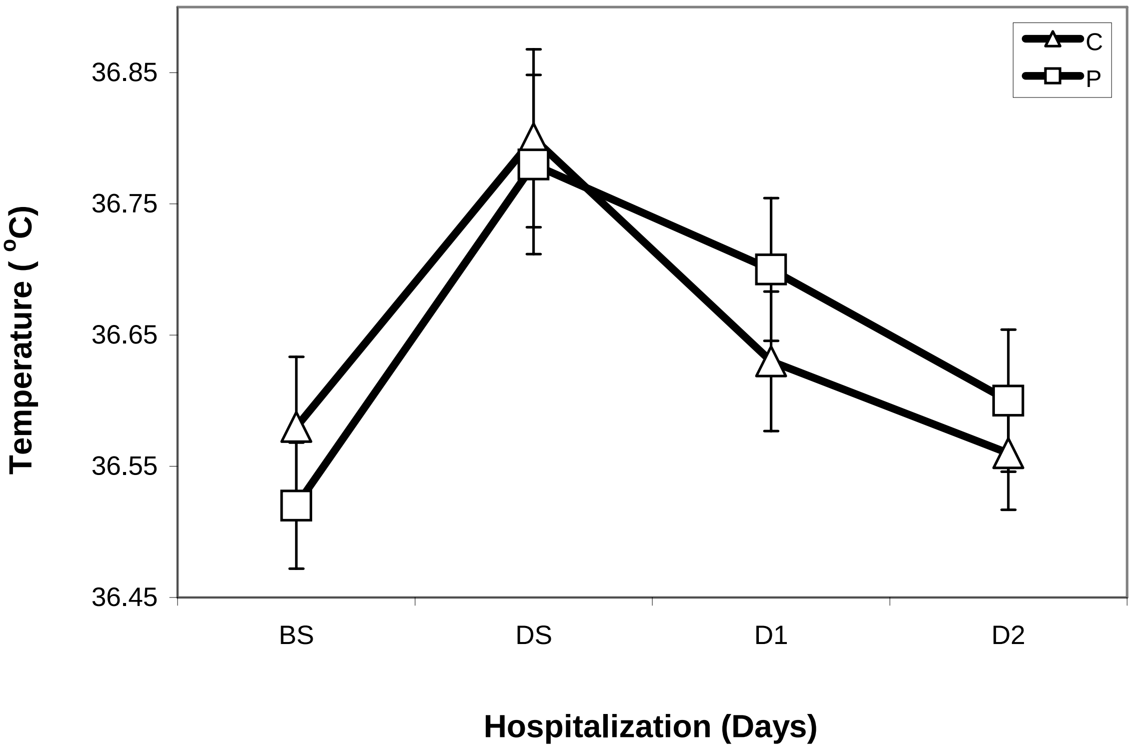

Fig. B.11. Comparisons of control (C) and plant (P) groups in temperature of patients with hemorrhoidectomy. Error bars label S.E. of estimates. BS, DS, D1, and D2 indicate before surgery, the day of surgery, first day after surgery, and second day after surgery, respectively.

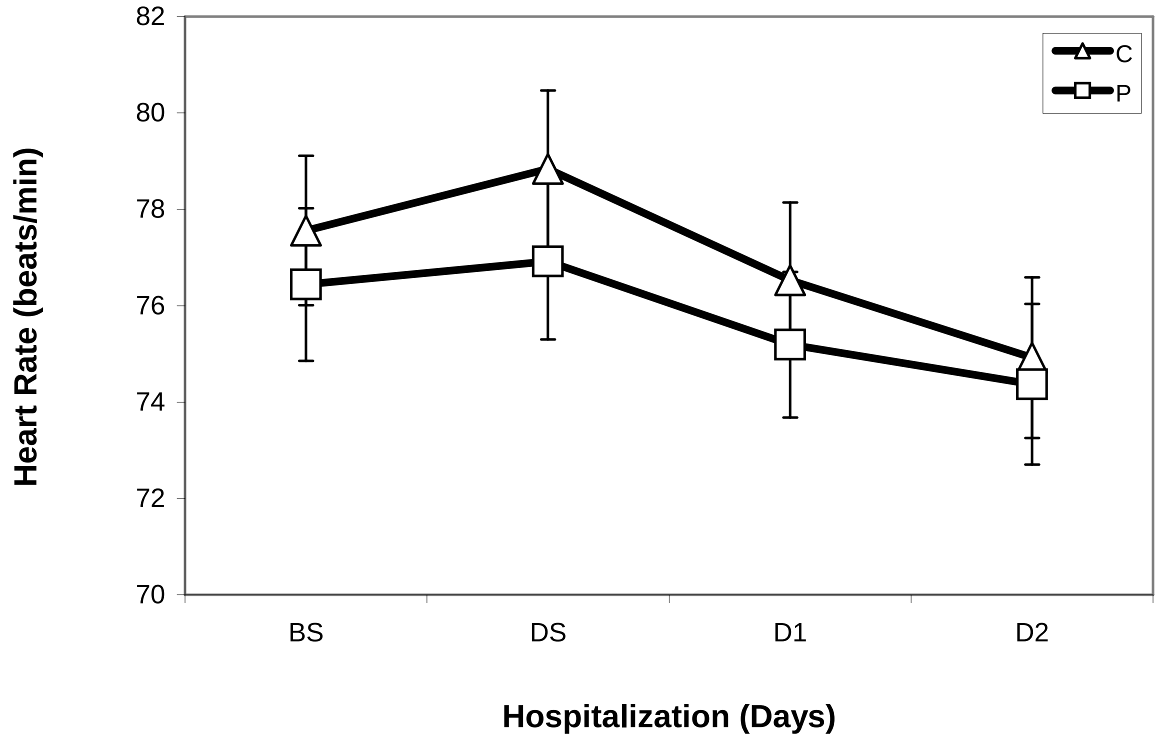

Fig. B.12. Comparisons of control (C) and plant (P) groups in heart rate of patients with hemorrhoidectomy. Error bars label S.E. of estimates. BS, DS, D1, and D2 indicate before surgery, the day of surgery, first day after surgery, and second day after surgery, respectively.

Table B.1. Mean and standard deviation (SD) of control and plant groups of patients with appendectomy in the rated NRS-101 for fatigue.

Hospitalization	Fatigue[z]	
	Control Group	Plant Group
Before Surgery	48.79 (13.63)	45.58 (15.29)
First Day After Surgery	78.61 (12.96)	76.48 (13.29)
Second Day After Surgery	56.10 (18.47)	53.03 (18.24)
Third Day After Surgery	30.42 (19.24)	23.37 (15.69)

[z]Fatigue: 0 = no fatigue, 100 = worst fatigue.

Table B.2. Mean and standard deviation (SD) of control and plant groups of patients with hemorrhoidectomy in the length of hospitalization.

	Hospitalization
Control Group	3.90 (0.51)
Plant Group	3.80 (0.49)

Table B.3. Selected descriptions of plant group patients' experiences with plants in hospital rooms during recovery from surgery.

Types of Patients	Descriptions[z]
Patients with thyroidectomy	"Flowers gave me a focus. When I returned to my room after surgery, I got so involved in them that I forgot my pain at that moment." "Having plants were unexpected happiness. I appreciate hospital for this opportunity." "I enjoy it very much. All patients should have this opportunity." "I like the green plants. They put me at ease. I was just relaxed." "This is the first time seen that hospital provides beautiful plants for patients. I like it." "Plants make a room feel much more alive and beautiful, and less sterile."
Patients with appendectomy	"Plants and flowers gave me a focus. Although my pain was severe, it seemed to be gone at that moment." "Surgery made me anxious. Watching plants made me relaxed." "I liked watching something indoors growing." "I want to know plants' name, so I can grow them in my house." "Orchids remind me my mother. She really loved it." "I enjoy them so much. They brighten a room up, they make the environment much nicer." "I have never seen or heard that hospital provides plants for patient' stays. I think this hospital really cares patients and I will come back here if any future hospitalization occurs in my life."
Patients with hemorrhoidectomy	"When I had surgery previously, I woke up tense, which made my pain worse. That didn't happen this time. Maybe plants help me relax." "Orchids were beautiful. I got so involved in them." "I love plants in my room. Do you know those names?" "I truly enjoyed watching plants in my room. All patients should have this opportunity." "I've never seen or heard before that hospital provides beautiful plants for patients. I feel like I am lucky." "Plants make a room homelike. They make me feel better."

[z] Comments were voluntary and collected from nurses, the researcher, and self-writings from the Patient's Room Satisfaction Questionnaire (PRSQ).