A THEORY-BASED, WEB-MEDIATED PHYSICAL ACTIVITY INTERVENTION FOR COLLEGE WOMEN

by

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ABSTRACT

Physical inactivity increases the risk for heart disease, type 2 diabetes, and obesity. Females, more than males, become increasingly inactive as they age. The primary aim was to develop and measure the effect of a theory-based, Web-delivered, physical activity intervention on walking behavior in college-aged women. The secondary aim was to perform a process evaluation to determine the efficacy of the intervention and explore potential mediating variables that explain changes in health behavior. A group of 121 college-aged women from Southern Utah University in Cedar City, Utah was recruited and randomly assigned to a 4-week intervention or control group. The intervention, based on Social Cognitive Theory of behavior change, used the internet to deliver theory-based interactive activities, such as behavioral capabilities, self-efficacy, outcome expectancies, reinforcement, and self-regulated walking. The control group was asked not to change their activity. Pre- and postintervention data were collected for steps per day (steps/d, Yamax SW 200 pedometer) and scores on the Exercise Self-Efficacy scale. To examine whether walking behavior increased as a result of the intervention, RM ANOVA was used to assess changes in steps/d over time. To examine whether self-efficacy was a mediating variable for the changes in walking behavior, a mediation model was tested and the significance of the model was determined using Sobel's test. Findings indicated that college-aged women who received the intervention were significantly more physically active (steps/d) than women who did not

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receive the intervention. Self-Efficacy partially mediated the intervention to increase physical activity. Process evaluation assessed the context and the recruitment and maintenance components of the study. Environmental, economic, and social factors contributed to increased walking behaviors. Fatigue, lack of time, and motivation were barriers to walking. Goal setting and self-monitoring promoted participation, whereas lack of time and motivation deterred participation in the program. This study reveals that a theory-based nursing intervention delivered via the Internet was instrumental in facilitating the adoption of routine walking in college women. Strengths and weaknesses of the intervention were identified through process evaluation and should be useful for those seeking to design similar interventions with this population.

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CHAPTER I

INTRODUCTION

Background

Sedentary lifestyles are distinguished by physical inactivity (<30 minutes of moderate-intensity physical activity per day) (Chakravarthy & Booth, 2003). Physical inactivity negatively impacts both individuals and society and has significant implications for the nursing profession. Individuals with sedentary lifestyles are at increased risk for several conditions, including heart disease, hypertension, obesity, type 2 diabetes, osteoarthritis, and some cancers (United States Department of Health and Human Services [USDHHS], 1996). Early mortality can be attributed to sedentary lifestyles (Haskell, 1994; Pate et al., 1995; USDHHS, 1996). Currently, poor diet and physically inactive lifestyles are the second highest cause of mortality (Mokdad, Marks, Stroup, & Gerberding, 2004).

Sedentary lifestyles adopted in the early years of life negatively impact the health care delivery system as individuals' age. Direct medical costs associated with poor health resulting from physical inactivity were $29 billion in 1987 and nearly $76.6 billion in 2000 (National Center for Chronic Disease Prevention and Health Promotion, 2004). In 2003, Medicare and Medicaid paid $39 billion in medical expenditures due to obesity alone (Finkelstein, Fiebelkorn, & Wang, 2004). A recently completed study for the State of Michigan found that 8.9 billion dollars were lost every year due to direct and indirect

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costs in medical care, worker's compensation, and lost productivity because of sedentary lifestyles. The State of Michigan estimated it could save $575 million per year if 5% (or 1 in 20) of the sedentary adults become physically active. Dollars spent on health care delivery systems could fund a school nurse in every public middle and high school or restore chronic disease prevention programs with extra monies available for new physical activity programming (Michigan Governor's Council of Physical Fitness, Health, and Sports, 2003). These studies indicate that the problem of physical inactivity is costly to both individuals and society; moreover, it has economic and practice implications for the nursing profession.

The sedentary lifestyle of women is particularly striking. By the time they reach college, young women become significantly less physically active than they were in high school. Their level of activity lessens even more as they move into their careers (Blair et al., 1995; Pate et al., 1995). Douglas and Collins (1997) found that 47% of 2258 college-aged women were sedentary and only 13% of college-aged women participate in moderately intense physical activity. Furthermore, weight gained during the college years is due to the lack of physical activity rather than increased caloric intake (Butler, Black, Blue, & Gretebeck, 2004).

The college years are a critical period for developing future lifestyles (Butler et al., 2004; USDHHS, 1996; Wallace, Buckworth, Kirby, & Sherman, 2000). If women do not develop behavioral skills to increase lifestyle physical activity during college, it is unlikely they will adopt a physically active lifestyle after entering the workplace (Wallace et al., 2000). Unfortunately, very few intervention studies have been designed to address this critical decrease in physical activity. Therefore, college-aged women are a

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high-risk group that health care professionals should target with health promotion interventions to prevent the adoption of sedentary lifestyles in the transition years from college to career.

Sedentary lifestyles are modifiable. Recent research (Dunn, Anderson, & Jakicic, 1998) emphasizes the importance of making physical activity a fundamental component of lifestyle. There has been a paradigm shift from promoting vigorous leisure activity to including physical activity at work, home, and in all aspects of daily living (Haskell, 1994; Sherwood & Jeffery, 2000; Tudor-Locke & Myers, 2001a).

Currently, the Centers for Disease Control and Prevention, the American College of Sports Medicine (ACSM), the World Health Organization (WHO), and the International Federation of Sports Medicine (IFSM) recommend that individuals become physically active by getting at least 30 minutes of moderately-intense physical activity on most if not all days of the week (Blair et al., 1995; Pate et al., 1995). Activity can be in one 30-minute block of time or broken into three 10-minute bouts with the same effect on health (Haskell, 1994; Pate et al., 1995; Thomas, Lewis, McCaw, & Adams, 2001). Furthermore, the *Healthy People 2010* initiative targets adults for physical activity interventions. One objective of *Healthy People 2010* is to increase the proportion of adults who engage in regular moderate-intensity physical activity for at least 30 minutes a day from 15% to 30% (USDHHS, 2000).

To address this *Healthy People 2010* goal, numerous physical activity intervention studies have been designed to increase regular moderate-intensity physical activity. Until recently, researchers have focused on interventions that may or may not use a behavior change theory to facilitate increased physical activity behavior. Likewise,

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some researchers have not used a behavior change theory to guide their intervention, even if they do use an objective measure of physical activity behavior. In addition, studies have not attempted to discern which factors predict intervention success, including mechanisms of change. Recent research shows that a combination of media-based and face-to-face interventions show promise in increasing physical activity behavior (Dishman & Buckworth, 1996; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998; Marshall, Owen, & Bauman, 2004). Examples of media-based interventions include printed materials and use of the internet, including a Web-based site to promote physical activity (McKay, King, Eakin, Seeley, & Glasgow, 2001; Whitely, 2001). Marshall and colleagues (2004) highlight the need for the development and systematic evaluation of studies using mediated approaches to deliver the intervention to determine why and how these interventions work.

It is important to target college-aged women with physical activity interventions given the health benefits of physical activity, the prevalence of women's inactivity, and the role of physical activity in reducing risk of sedentary lifestyle-associated conditions. Walking is an appealing method for increasing physical activity and several authors have reported that walking is the most popular physical activity for women and can provide health-enhancing benefits (Ransdell, Vener, & Sell, 2004; USDHHS, 1996; Wallace, 2003).

The proposed study addressed gaps in the literature on physical activity interventions in three ways. First, Social Cognitive Theory (SCT) (Bandura, 1986) was used to design, implement, and evaluate the intervention. Behavior change theories, such as Social Cognitive Theory, provide information about the problem being studied, the

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expected outcomes, the mediating processes, and the mechanisms through which the mediating processes occur (Sidani & Braden, 1998).

Second, a limitation in the current research was addressed with the use of an objective measure of physical activity, the pedometer, rather than a subjective measure, self-report. Compared to objective measures of physical activity assessment, self-report methods, such as questionnaires, have higher measurement errors due to recall and social-acceptability biases (Sarkin, Nichols, Sallis, & Calfas, 2000).

Third, a systematic process evaluation of the intervention was completed. Process evaluations determine how and why an intervention was or was not successful (Sidani & Braden, 1998). Components of process evaluation include assessing recruitment strategies, maintenance strategies, intervention delivery, and mediating processes.

Most importantly, many studies have not investigated the *mechanisms* of change that influence behavior change based on mediating variables from behavior change theories. A mediator is defined as a theoretical variable that acts to complete a causal link between the intervention and the expected behavioral outcome (Sidani & Braden, 1998). An understanding of how theory guides and analyzes changes in health behavior successfully informs practitioners on how to alter existing interventions for greater usefulness.

The Problem

Female college students are at risk for sedentary lifestyles in the transition years between college and career. Lifestyle physical activity emphasizes increasing one's usual daily activities to a level such that one is meeting standard physical activity

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recommendations. There are potential health benefits of increased physical activity and using pedometers effectively measures physical activity; however, there are few studies that use behavior change theory and Web-based media to promote increased lifestyle physical activity in female college students. Additionally, process evaluations to determine strengths and weaknesses within the intervention and the mechanisms of change that occur through the behavioral change theory have not been done.

Significance

Approximately 31% of young adults are enrolled in colleges and universities (Southern Regional Education Board, n.d.). Nurses are in a good position to develop programs that promote lifestyle physical activity through college-supported wellness centers. This research provides additional knowledge about a theory-based and Web-mediated physical activity intervention for college-aged women. The process evaluation identified strengths and weaknesses of the intervention that can be used to develop interventions that are more effective in the future.

Purposes, Hypotheses, and Research Questions

The main purposes of this experimental, repeated measures study were to (1) use Social Cognitive Theory to design and implement an intervention (SUU Women on the Move Walking Program) to promote and increase lifestyle physical activity in college-aged women that was administered by Web-based media (Web-CT); and (2) use a process evaluation to assess the effectiveness of the intervention's implementation in terms of increasing physical activity including the exploration of a potential mediating

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variable that explains changes in health behavior. A series of hypotheses and research questions related to the main purposes of the study were investigated.

Purpose 1

The first purpose of this study was to use Social Cognitive Theory to design and implement a theory-based 4-week physical activity intervention to promote and increase lifestyle physical activity in college-aged women that was administered by Web-based media (Web-CT).

Hypothesis

College-aged women using a pedometer and receiving a Web-based physical activity intervention (SUU Women on the Move Walking Program) will have significantly greater mean pedometer steps than college-aged women not receiving the intervention.

Purpose 2

The second purpose was to use a process evaluation to assess the effectiveness of the intervention's implementation in terms of increasing physical activity including the exploration of a potential mediating variable that explains changes in health behavior.

Hypothesis

Increased self-efficacy will mediate the relationship between the intervention and physical activity in college-aged women who are exposed to a Web-based physical activity intervention (SUU Women on the Move Walking Program).

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Research Question 2A

According to the participants, what social, economic, and environmental factors contributed to participation in the SUU Women on the Move walking program?

Research Question 2B

According to the participants, what factors contributed to successfully recruiting college-aged women to participate in the SUU Women on the Move walking program?

Research Question 2C

According to the participants, what program factors contributed to keeping college-aged women actively involved in the SUU Women on the Move walking program?

Definition of Terms, Delimitations, and Assumptions

Definition of Terms

Study variables were operationally defined as follows:

Lifestyle Physical Activity: The "daily accumulation of at least 30 minutes of self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life" (Dunn et al., 1998, p. 399).

Physical Activity Level: The intensity, frequency, or duration of lifestyle physical activity in which one engages. For this study, physical activity level was ascertained by participants wearing a pedometer and recording steps taken per day.

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Physical Activity Intervention: A 4-week walking program designed to increase lifestyle physical activity through a theoretically based and internet-mediated educational program focused on setting goals, monitoring activity, social support, barrier identification, and strategies to deal with barriers.

Web-CT: Intervention delivered through Web-CT. Web-CT can be defined as "any purposeful considered application of Web technologies to the task of educating a fellow human being" (Horton, 2000, p. 2).

Intervention Effectiveness: Intervention effectiveness was established by performing a process evaluation. Process evaluation is "a form of program monitoring designed to determine whether the program is delivered as intended to the target recipients" (Rossi, Lipsey, & Freeman, 2004, p. 64). Process evaluations differ from outcome evaluations in that process evaluations provide knowledge of the program's activities and outcome evaluations ask "whether the desired outcomes were attained and whether those changes included unintended side effects" (Rossi et al., 2004, p. 58). Process evaluations are especially important when an intervention is unsuccessful. The physical activity intervention program was deemed effective in increasing the physical activity level of participants by monitoring behavioral outcome, recruitment and maintenance measures, and context in which the intervention occurs. Last, each participant in the intervention was asked to evaluate the Website and program factors.

Potential Mediating Variable: A theoretically derived characteristic that may influence the ability of participants to change their behavior. Self-Efficacy is broadly defined as a person's confidence about his or her capabilities to manage events

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that affect one's life (Bandura, 1997). For this study, a 15-item scale was used to measure a person's confidence about participating in daily exercise (e.g., self-efficacy).

Delimitations

Participants in this study were college-aged women interested in increasing their physical activity level through walking and who had access to internet technology. Inclusion criteria consisted of college-aged women who (1) were aged 18 to 34 years, (2) were not considered physically active as determined by researcher-developed questions, (3) could walk unassisted, (4) could follow directions and had the time and desire to participate, and (5) reported feeling comfortable using computer technology on a short survey. Exclusion criteria included those women who were athletes at their university or were majoring in physical education or dance.

Assumptions

Two assumptions were made for the purpose of this study. First, participants will respond truthfully and accurately when reporting their pedometer steps, self-efficacy beliefs, and response to questions related to context, recruitment, and maintenance factors; and, second, interventions designed to increase ambulatory activity in women can promote the development of optimum health and well-being.

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CHAPTER II

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Numerous physical activity interventions have been conducted over the past decade. Intervention research with adolescents, adults, women, seniors, in homes, and at work-sites in Australia, Europe, and the United States has used the Social Cognitive Theory (SCT) of Behavior Change (Bandura, 1986). In contrast, little work has been done using process evaluations of these interventions to help explain positive, modest, and insignificant results, including assessment of the mechanisms by which theoretical variables contribute to change in individual behavior. Finally, studies often lack an objective measure to determine physical activity level.

This literature review was categorized into the following sections: (1) physical activity of college-aged women; (2) walking as a mode of physical activity; (3) measurement of physical activity; (4) theoretical basis of physical activity interventions; (5) intervention delivery methods; (6) process evaluation, including mediation of theoretical variables; and (7) the theoretical framework.

Physical Activity of College-Aged Women

Research suggests that by the time young women reach high school and college, they become significantly less physically active (Blair et al., 1995). Unfortunately, they become even less active as they move into their careers (Blair et al., 1995; Brown &

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Trost, 2003; Leslie, Fotheringham, Owen, & Bauman, 2001; Seefeldt, Malina, & Clark, 2002). Women significantly reduce their activity level between the ages 6 to 12 years and 13 to 18 years (Wallace, 2003). Furthermore, weight gained during the college years may be due to the lack of physical activity rather than increased caloric intake (Butler et al., 2004). Although Douglas and Collins (1997) found that 47% of 2,258 college-aged women were sedentary and only 13% participated in moderately intense physical activity, a recent study by Behrens and Dinger (2005) using pedometers to measure physical activity level found there was no significant difference in activity level between male and female college students. Furthermore, they revealed that college-age females (n = 441; mean age = 20.05 ± 1.82; BMI = 23.97 m/kg^2, ± 3.79) at the University of Oklahoma were very active (11,364 steps/day ± 2995). They also reported that students took more steps on weekdays compared to weekends.

Physical Activity Interventions Using College Students

While the college years are a critical period for developing future lifestyles (Butler et al., 2004; USDHHS, 1996; Wallace et al., 2000), very few intervention studies address the lifestyle needs of this population. Only three physical activity interventions were published that focused on college students. Two studies used health promotion classes to increase physical activity levels and reported no increase in physical activity level (Cardinal, Jacques, & Levy, 2002; Sallis et al., 1999). One possible explanation for the results of these studies is that the content of the courses focused on overall health issues rather than concentrating only on physical activity. Additionally, both studies used self-report to measure physical activity behavior, which may be less sensitive to changes

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in physical activity behavior. In a third study, Woods and colleagues (2002) mailed physical activity promotion material to students over a 2-year period. Success of the intervention was evaluated by the number of students who joined a school-run fitness center. While students receiving physical activity literature joined a fitness center, changes in their physical activity were not measured.

Physical Activity Determinants of College-Aged Women

Although these intervention studies included women in the samples, the intervention was not tailored to address determinants of physical activity that are important to women, such as activity type and time constraints. Several studies (Barnes & Schoenborn, 2003; Hall, Kuga, & Jones, 2002; Siegel, Brackbill, & Heath, 1995) report that women were less physically active than men. Additionally, younger women were more active than older women (Belza & Warms, 2004; Brown & Trost, 2003).

Toward answering the question of what are important issues to women, many studies suggest that women do not value sport and leisure-time physical activity as much as lifestyle physical activity or "exercise with a purpose" (Belza & Warms, 2004, p. 187). From a woman's perspective, physical activity must not only be fun and enjoyable (Ransdell, Robertson et al., 2004) but must not take time away from family members who have needs or other household demands (Belza & Warms, 2004; Grubbs & Carter, 2002; Jaffe, Lutter, Rex, Hawkes, & Bucaccio, 1999; Ransdell, Vener et al., 2004). Guilt about family and household needs was one reason given for not being physically active (Belza & Warms, 2004; Yoshida, Allison, & Osborn, 1988; White, 2004). Specifically, women who are married or have children have lower levels of physical activity (Belza & Warms,

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2004; Brown & Trost, 2003). Safety concerns, such as crime, loose dogs, and lack of sidewalks, were additional reasons given for being physically inactive (Ransdell, Vener et al., 2004).

In similar studies (Grubbs & Carter, 2002; Jaffe et al., 1999; Makrides, Veinot, Richard, McKee, & Gallivan, 1998; Yoshida et al., 1988), lack of time or motivation were common reasons given for physical inactivity. Finally, several authors (Belza & Warms, 2004; Crespo, Keteyian, Heath, & Sempos, 1996; Hall et al., 2002; Makrides et al., 1998; Ransdell, Vener et al., 2004; Wallace, 2003) stated that the preferred physical activity of women was moderately intense walking.

Belza and Warms (2004) identify other predictors of physical activity among women as social support, access to recreational areas, and socioeconomic status. Positive social support from family or friends was associated with increased physical activity levels in women (Cox, Burke, Gorely, Beilin, & Puddy, 2003; Lombard, Lombard, & Winett, 1995). Social support could be through direct means (exercising with a friend) or indirect means (watching of the children). Modeling by physically active neighbors was found to increase physical activity behavior (Addy et al., 2004; Sallis & Owen, 1999). Addy and colleagues also reported that sidewalks in good repair and better lighting were associated with increased physical activity. Lower socio-economic status was associated with greater physical inactivity (Brown & Trost, 2003; Lee & Cubbin, 2002).

Physical Activity Intervention Studies for Women

Several intervention studies (Barrett, 2000; Cox et al., 2003; Dallow & Anderson, 2003; Maxwell, Bastani, Vida, & Warda, 2002; Nies, Chruscial, & Hepworth, 2003;

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Speck & Looney, 2001; Swartz, Strath et al., 2003; Whitely, 2001; Wilbur, Chandler, & Miller, 2001; Wilde, Sidman, & Corbin, 2001) specifically designed for women used lifestyle physical activity and walking as the mode for physical activity. Although most of these interventions increased physical activity in women, they targeted middle-aged (Barrett, 2000; Dallow & Anderson, 2003; Nies et al., 2003; Speck & Looney, 2001; Swartz, Strath et al., 2003; Whitely, 2001; Wilbur et al., 2001; Wilde et al., 2001) and older women (Cox et al., 2003; Maxwell et al., 2002). Research using females within the family unit as the exercise cohort has been the focus of several studies by Ransdell and several colleagues (2001, 2002, 2003, 2004).

Only one study was found that targeted college-aged women. Sidman, Corbin, and Le Masurier (2004) used pedometers to evaluate differences in goal attainment between a targeted 10,000 steps/day goal and more personalized goals. Participants randomized to the personalized goal group added 1000 to 3000 steps to their baseline pedometer steps each week. They found that women in the personalized step goal group who met their goal were walking 10,000 steps/day after a 3-week intervention. Additionally, they found that women with initially low baseline steps had difficulty reaching the 10,000 steps/day goal. Findings from this study are difficult to generalize because it was not theory-based; there was no control group and the researchers did not describe the sample.

In summary, college-aged women are at risk for physical inactivity. Few intervention studies target this population. Whereas women were included in interventions using college populations, these interventions were not tailored to the special needs and interests of women. Women feel that physical activity must not take

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time away from the needs of others or demands of their responsibilities. Therefore, population-specific interventions to increase physical activity need to be developed for women of college age. White (2004) opines that effective interventions should include strategies for increasing the perception among women that in order to care for others, "she *must* take care of herself *first*" (p. 110). Therefore, interventions should provide strategies for increasing self-worth and decreasing the barriers of lack of time and motivation for being physically active. Interventions also should address increasing social support systems and access to places to be physically active.

Walking as a Mode for Physical Activity

It makes sense to investigate walking as the mode for physical activity because recent research emphasizes the importance of making physical activity a fundamental component of one's lifestyle and that walking was the preferred activity of most women (Belza & Warms, 2004; Ransdell, Vener et al., 2004; Wallace, 2003). There has been a paradigm shift from promoting vigorous leisure activity to including physical activity at work, home, and in all aspects of daily living (Belza & Warms, 2004; Haskell, 1994; Sherwood & Jeffrey, 2000; Tudor-Locke & Myers, 2001a). Also called *lifestyle physical activity*, this activity includes "all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life" (Dunn et al., 1998, p. 399). It is currently recommended that individuals do at least 30 minutes of moderately intense physical activity 5 to 7 days per week (Blair, LaMonte, & Nichaman, 2004). The activity can be in one 30-minute

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block of time or broken into three 10-minute blocks with the same effect on health (Haskell, 1994; Pate et al., 1995; Thomas et al., 2001).

Walking is a moderately intense form of physical activity and can provide health-enhancing benefits (Haskell, 1994; Thompson, Rakow, & Perdue, 2004; USDHHS, 1996). Studies (Barnes & Schoenborn, 2003; Bassett, Cureton, & Ainsworth, 2000; Martin, Morrow, Jackson, & Dunn, 2000; Tudor-Locke & Myers, 2001a) show it may be easier for people to walk rather than initiate another behavior because walking is an activity most everyone does during daily life. However, most studies have been conducted using middle-aged and older adults; findings cannot be generalized to college-aged women.

Walking allows physical activity to fit into daily activities with multiple bouts instead of a single block of time (Dunn et al., 1998; Sherwood & Jeffery, 2000). Walking is low impact so it is less likely to cause impact-related injuries. Adherence to a program of physical activity also is typically high if walking is part of it (Lombard et al., 1995; Wilbur et al., 2001). Walking can be done without an audience, minimizing the potential for embarrassment or intimidation (Grubbs & Carter, 2002; Sherwood & Jeffery, 2000). Furthermore, cost is not a factor with walking as there are no commuting, gym membership, or special facilities required (Dunn et al., 1998; Grubbs & Carter, 2002; Sherwood & Jeffery, 2000). Finally, no special or revealing clothing is needed. Special clothing may limit participation due to extra costs or the potential for embarrassment or intimidation (Grubbs & Carter, 2002).

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Studies That Used Walking as Mode of Physical Activity

Walking as a mode of physical activity has been examined for its ability to provide health-enhancing benefits (Kirk et al., 2001; Kirk, MacIntyre, Mutrie, & Fisher, 2003; Nies et al., 2003; Oja, Vuorie, & Paronen, 1998; Swartz, Strath et al., 2003; Talbot, Gaines, Huynh, & Metter, 2003), promote adherence to a program of physical activity (Lombard et al., 1995; Powers-Noland, 1989; Wilbur et al., 2001), and increase physical activity levels (Barrett, 2000; Crouteau, 2004; Hager, Hardy, Aldana, & George, 2002; McKay et al., 2001; Mutrie et al., 2002; Napolitano et al., 2003; Reger et al., 2002; Speck & Looney, 2001, Whitely, 2001, Wilde et al., 2001). Walking as an intervention increased physical fitness (Nies et al., 2003; Oja et al., 1998; Talbot et al., 2003), decreased blood pressure (Nies et al., 2003; Swartz, Strath et al., 2003), and increased glucose tolerance (Kirk et al., 2003; Swartz, Strath et al., 2003). Only one study (Kirk et al, 2001) was found that examined walking and health-related quality of life. This intervention significantly improved vitality and mental health within health-related quality of life in the intervention group.

Adherence to a walking program was enhanced in the intervention group (Lombard et al., 1995) when goal setting, self-monitoring, and prompting were included in the intervention. A similar walking study (Powers-Noland, 1989) found that either self-monitoring or reinforcement through rewarding oneself increased walking activity in the intervention group as compared to the control group. Adherence increased when the use of an objective measure of physical activity and activity logs were used (Wilbur et al., 2001).

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Four studies (Hager et al., 2002; Mutrie et al., 2002; Napolitano et al., 2003; Reger et al., 2002), using self-report to measure physical activity level, found that time spent in walking increased in the intervention groups. Four different studies (Crouteau, 2004; Speck & Looney, 2001, Talbot et al., 2003; Wilde et al., 2001) found that pedometers were especially motivating in increasing daily ambulatory activity among those in the intervention groups. Walking increased in both intervention and comparison groups in studies by Barrett (2000), McKay and colleagues (2001), and Whitely (2001). This finding suggests that behavior change can occur in comparison groups merely as a result of receiving information about physical activity (Kirk et al., 2003).

Summary

In summary, participants increased their physical activity levels, had positive health benefits, and increased adherence to exercise through walking interventions. Several studies did not use a control group within their design (Crouteau, 2004; Oja et al., 1998; Reger et al., 2002; Wilbur et al., 2001) or had a comparison group rather than a control group (Barrett, 2000; Kirk et al., 2001; 2003). Only one of these studies used college-age women as a sample. Statistical power may have been low because of the small sample size used in some studies. Finally, several studies did not use an objective measure of physical activity level but rather relied on self-report measures. A summary of literature related to walking as a mode for physical activity interventions is presented in Appendix A. Each study; sample size and characteristics; purpose and design; and measures of outcomes, findings, and limitations are presented. Because the method used

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to measure physical activity levels is important to the outcomes of the intervention. The next section will describe methods used in the measurement of physical activity.

Measurement of Physical Activity

The most common measures used for physical activity outcomes are the indirect, or subjective; methods of self-report questionnaires and the direct, or objective, methods of heart rate monitors; accelerometers; and pedometers. The advantages and disadvantages of both methods are discussed.

Subjective Measures—Self-Report

Subjective measures include self-report questionnaires, activity logs, diaries, and journals. Although self-report questionnaires are easy and inexpensive to administer to large samples, there are many problems associated with using them to assess walking. Many self-report measures of walking have not been validated for use in population-based studies and are often unreliable (Dishman, 1994; Sarkin et al., 2000). In general, reliability ranges from 0.14 to 0.36 for global measures of activity and 0.50 to 0.56 for recall measures (Matthews, 2002). Sallis and colleagues (1997) observed that directions for completing surveys were easily misunderstood. They found that self-report surveys underestimated walking in college students because they did not interpret lifestyle physical activity (such as walking to classes and other incidental walking) as "exercise." Bassett, Cureton, and Ainsworth (2000) stated that walking can be underestimated by as much as five-fold using self-report methods.

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Objective Measures—Heart Rate Monitors, Accelerometers, and Pedometers

Objective measures include heart rate monitors, accelerometers, and pedometers. Heart rate monitors consist of an electrocardiogram (ECG) transmitter attached to the chest by a strap that transmits wireless radio signals to a microprocessor receiver worn on the wrist. Heartbeats per minute are recorded every 5, 15, or 60 seconds (Janz, 2002). Accelerometers are small, noninvasive, motion detectors that measure vertical and/or horizontal acceleration of the body. Accelerometers record movement as "activity counts" (Welk, 2002). Pedometers are motion detectors that count the number of steps taken. They are small, 2x2 inch, devices worn on the belt or waistband that measure vertical body displacement with a spring-suspended lever that moves up and down with each step (Bassett & Strath, 2002).

Heart rate monitors, accelerometers, and pedometers can be used for long-term monitoring of physical activity. Since heart rate monitors record heartbeats per minute over time, they can be used to assess pattern and intensity of physical activity. Heart rate monitors measure physical activity as a function of energy expenditure. Validity has been reported between heart rate monitors and direct observation (r = .64) (Janz, 2002). Reliability of heart rate monitors should be established by monitoring for at least 4 days to obtain an acceptable correlation coefficient of .80 (Janz, 2002). However, heart rate is influenced by many factors other than physical activity, including emotional stress, stimulants, fatigue, and dehydration. Additionally, heart rate is poorly correlated with sedentary and light physical activity (Janz, 2002). In some participants, wearing the chest strap and wristwatch for long periods may increase subject burden and contribute to skin

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breakdown. Finally, heart rate monitors are expensive and require computer software to download data for analysis.

In contrast to heart rate monitors, accelerometers and pedometers are best used for ambulatory activity. Accelerometers record "activity counts" for which "cut-points" for activity counts/minute that correspond to energy expenditure have been developed (Nilsson, Ekelund, Yngve, & Sjostrom, 2002). Pedometers display "steps taken" on the front of the device, which means pedometers can be used to motivate participants to increase ambulatory activity whereas accelerometers cannot be used for this purpose because data are not displayed. Similar to the accelerometer, pedometer step-count indices have been established that identify sedentary (<5000 steps), inactive (5000-7499 steps), somewhat active (7500-9999 steps), and very active (≥10,000 steps) behavior in adults (Tudor-Locke & Bassett, 2004). Tudor-Locke and Bassett (2004) reviewed the literature including descriptive, correlational, and intervention studies to develop the above indices for use in classifying pedometer-determined physical activity level in adults.

Although accelerometers and pedometers are equally accurate, both have problems with sensitivity (Swartz, Bassett, Moore, Thompson, & Strath, 2003). Compared to pedometers, accelerometers record less activity if walking or running up an increasing grade and more nonambulatory activity, such as fidgeting and riding in a car (Swartz, Bassett et al., 2003). Pedometers tend to miss recording steps taken at speeds of 1 to 2 mph (Le Masurier & Tudor-Locke, 2003; Swartz, Bassett et al., 2003).

Accelerometers are expensive ($200 to $500) and require computer software to download data for analysis. There also are six different types of accelerometers that give

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different output data making interpretation difficult (Welk, 2002). Validity studies have shown that accelerometers underestimated energy expenditure associated with free-living conditions by 38% to 48%, depending on the type of accelerometer (Welk, 2002). Reliability between different types of accelerometers ranged from .62 to .91 (Brage, Wedderkopp, Franks, Andersen, & Froberg, 2003; Welk, Schaben, & Morrow, 2004). Reliability in studies can be increased to .80 by sampling activity for at least 4 days (Welk, 2002) and using accelerometers that have high unit-to-unit reliability (Welk, Schaben et al., 2004). Scruggs (2005) found that pedometers (r = .91) have better reliability in measuring moderate to vigorous physical activity than CSA accelerometers (r = .88).

In contrast to accelerometers, pedometers are relatively inexpensive ($15 to $30) and do not require computer software to analyze data. Use of pedometers is an efficient, valid, and reliable method of measuring walking behavior (Le Masurier & Tudor-Locke, 2003). However, whereas pedometers measure the amount of walking, they do not measure the intensity or duration of walking. A pedometer (model LS2525), distributed by Walk-4-Life, has a timer that starts with activity. Using this pedometer, steps/time is measured; therefore, one can attempt to assess intensity. However, although the LS2525 has shown reliability with less than 1% error in a recent study (Schneider, Crouter, & Bassett, 2004), it has five functions - timer, clock, steps, distance, and calories - that may be confusing for research participants who are not familiar with pedometers. Difficulties in using a multifunction pedometer to obtain steps taken and time in activity may decrease motivation, introduce recording error, and increase burden for participants. Only one reliability study was found in which the LS2500 (a pedometer that shows only time

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and steps) demonstrated a reliability coefficient of $r = .81$ in comparison with a reliability coefficient of the Yamax Digiwalker SW200 of $r = .91$ (Melanson et al., 2004).

Pedometers can also be sealed to "blind" participants to knowledge of their steps (Tudor-Locke & Myers, 2001b). Blinding is done to prevent the motivating effect of feedback from the pedometer's display. The data collection method used to record the steps taken is an issue that needs to be addressed when sealed pedometers are used. Tudor-Locke and Myers (2001b) give several options, including (1) having the participant return the pedometer to a certain location to have steps recorded by the researcher, (2) having the researcher go to the participant's home to record steps, and (3) having the participant mail the pedometer to the researcher. Mailing pedometers results in additional jarring that may occur in transit that can add step counts (Tudor-Locke & Myers, 2001b). Researchers who go to participants' homes should immediately record the steps from the pedometer's display (Tudor-Locke & Myers, 2001b). Finally, researchers can arrange to meet participants every week at the same time to record steps and reset the pedometer. The participant can then wear the pedometer continuously (during waking hours) until the next week at the same time (Dr. C. Tudor-Locke, personal communication, September 6, 2004).

The use of pedometers as a motivating tool for individuals to establish step goals can be more difficult because of confusion surrounding recommendations for physical activity. Several researchers have examined how many steps are needed to meet the current requirements for physical activity (i.e., a 30-minute walk). Hatano (1997) emphasizes 10,000 steps/day but Le Masurier, Sidman, and Corbin (2003) found that it is not necessary to accumulate 10,000 steps to achieve a 30-minute walk above normal

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daily activity. They recommended adding steps equivalent to 30 minutes of walking to baseline steps.

While there is growing evidence that 10,000 steps/day is an indicator of good health (Tudor-Locke & Bassett, 2004), it may not be possible for sedentary women to maintain a 10,000-step goal (Tudor-Locke, 2002). Tudor-Locke (2002) stresses that the main objective in working with sedentary populations is to get them moving; therefore, an intervention focusing on personalized goals may be less intimidating, increase confidence in achieving the goal, and make an exercise program more appealing. Interventions that increase walking have shown positive health results. Research suggests, for example, the more walking women do as measured by pedometers, the less percent of body fat they have (Thompson et al., 2004).

Recommendations for personalized goals for steps/day for starting physical activity include (1) adding 2000 steps to the baseline pedometer steps each day or week until they build up to 10,000 steps (http://www.americaonthemove.org/LearnMore.asp); (2) adding 1000 to 3000 steps to the baseline pedometer steps each week (Sidman et al., 2004); and (3) having the participant walk for 10 minutes, multiplying the step count by 3 for a 30-minute step count and adding this number to the baseline obtained previously (Tudor-Locke, 2002). Other researchers recommend adding 10% to 30% of the baseline steps to the baseline pedometer steps each week until 10,000 steps are attained (Crouteau, 2004; Talbot et al., 2003).

In a recent study comparing the 10,000-step goal to personalized step goals, Sidman and colleagues (2004) found that women who attained their step goals, those assigned to the personalized step goal group, had similar step counts to women assigned

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to the 10,000 steps/day goal group by the end of the intervention. Women with initially low baseline step counts were less likely to attain their goal regardless of their group assignment. Therefore, initially low baseline step counts may signify the need for greater motivation within an intervention for these women to attain either targeted or personalized step goals.

Studies That Used Objective Measures to Measure Physical Activity

There is a limited amount of research that has evaluated outcomes of physical activity interventions using objective measures, including pedometers. Two studies (Kirk et al., 2001, 2003) used accelerometers to determine if counseling increased ambulatory activity in adults with type II diabetes mellitus. Their results found physical activity increased significantly more in the group who received counseling than in those who received a printed brochure on the benefits of physical activity. Wilbur and colleagues (2001) used an activity log and Polar Heart Rate Monitor to measure physical activity level in 156 women over a 24-week intervention. Although their study showed that 77% of previously sedentary women were still walking at the end of the program there was no control group and data analysis suffered from loss of data due to battery failure in the heart rate monitors. Two studies (Talbot et al., 2003; Wilde et al., 2001) used both accelerometers and pedometers to measure ambulatory activity. While both studies found that participants significantly increased their amount of walking, neither study grounded their intervention on a behavior change theory. Additionally, Wilde and colleagues (2001) did not use a control group. Ransdell, Robertson, Ornes, and Moyer-Mileur (2004) used pedometers to determine if a home-based physical activity intervention with

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mothers, daughters, and grandmothers could increase walking behavior. They found that steps taken in the intervention group increased by 37% compared to a 13% decline in the control group. There were a number of limitations with this pilot study including small sample size and large attrition from the control group, which decreased statistical power. Three studies (Crouteau, 2004; Speck & Looney, 2001; Swartz, Strath et al., 2003) reporting use of pedometers and daily activity logs as part of their intervention found that participants significantly increased the amount of walking.

Calibration of pedometers prior to measuring physical activity levels can influence reliability in studies. According to Tudor-Lock and Myers (2001b), pedometers should be calibrated with each participant prior to beginning data collection. It has been recommended that participants walk and count 50 to 100 steps and then compare the counted value to the steps displayed on the pedometer to calibrate the pedometer (Tudor-Locke & Myers, 2001b; Vincent & Sidman, 2003). Only two studies (Swartz, Strath et al., 2003; Talbot et al., 2003) reported using procedures to assure calibration of the pedometer with participants. Swartz, Strath, and colleagues (2003) stated that 18 participants in their study walked 20 steps and compared this with the pedometer display. Talbot and colleagues (2003) stated that all 34 participants walked a 4.88 km sidewalk course and actual steps were compared to pedometer steps. All pedometers used in this study were within 1% of the actual count.

Last, one study (Eastep, Beveridge, Eisenman, Ransdell, & Shultz, 2004) examining motivational effect of pedometers found there was no difference in steps taken between those with sealed pedometers and those with unsealed pedometers. Several limitations were noted in this study including the small sample size ($n = 26$), data

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collected for only 3 weeks, and the failure to obtain participants' baseline steps. This last limitation was important because it was not possible to determine if steps were increased from baseline.

In summary, studies reporting the use of pedometers and other objective measures of physical activity were successful at increasing participants' physical activity behavior; however, researchers reported small sample sizes. A summary of literature related to studies using objective measures to determine physical activity level is presented in Appendix A. Each study; sample size and characteristics; purpose and design; and measures of outcomes, findings, and limitations are presented. Because interventions should be grounded in theory, the next section describes the theoretical basis used to develop physical activity interventions.

Theoretical Basis of Physical Activity Interventions

Nurse researchers are in a good position to study physical activity behavior and test interventions to promote lifestyle physical activity (Robbins et al., 2001). Targeted health behavior change programs are derived from theory to teach individuals skills needed to include moderate-intensity physical activity into daily routines. Use of behavior change theory shapes interventions aimed at facilitating intrapersonal and interpersonal strategies to reduce barriers to physical activity.

Theory, which provides the framework for research, has been defined as the "set of statements that tentatively describe, explain, or predict relationships between concepts" (Powers & Knapp, 1995, p. 170). Glanz, Rimer, and Lewis (2002) classify behavioral change theory by its purpose to explain, predict, or change behavior. They

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assert that *explanatory theories*, such as the Transactional Model of Stress and Coping, help to identify and explain behavior; *predictive theories,* such as Theory of Planned Behavior, help to identify the mediating variables that change behavior; and *change theories,* such as Transtheoretical Model, direct the development of interventions.

Studies That Did Not Use Theory-Based Interventions

A number of physical activity intervention studies (Cardinal et al., 2002; Cox et al., 2003; Crouteau, 2004; Lombard et al., 1995; Loughlan & Mutrie, 1997; Maxwell et al., 2002; McKay et al., 2001; Nies et al., 2003; Oja et al., 1998; Powers-Noland, 1989; Swartz, Strath et al., 2003; Talbot et al., 2003; Titze, Martin, Seiler, Stronegger, & Marti, 2001; Wilde et al., 2001) were conducted without establishing a theoretical basis from behavior change theory for the intervention content. Instead, these studies used correlates or determinants found to predict physical activity behavior from descriptive, correlational studies rather than behavioral and cognitive variables that promote behavior change. While information on correlates and determinants of physical activity behavior derived from descriptive studies provide evidence of mediators from explanatory and predictive theories, change theories are recommended for designing effective physical activity intervention studies (Biddle & Nigg, 2000; Robbins et al., 2001). The following are examples of studies that used correlates or determinants found to predict physical activity behavior.

Educational Methods

Educational media campaigns or organized lectures to increase awareness about physical activity were successful in increasing physical activity behavior (Loughlan &

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Mutrie, 1997; Maxwell et al., 2002; Oja et al., 1998; Titze et al., 2001). Two studies (Oja et al., 1998; Titze et al., 2001) used media campaigns, daily physical activity breaks, and workshops in the workplace to significantly increase the level of physical activity in employees. Similar to the walking studies, one study (Loughlan & Mutrie, 1997) found that behavior change could occur in comparison groups as a consequence of receiving information about physical activity. Three methods of educating groups about physical activity were examined: fitness assessments, exercise consultations, and receipt of an information booklet. All groups significantly increased their physical activity.

In contrast, two studies (Cardinal et al., 2002; Cox et al., 2003) using educational or fitness classes showed no difference in physical activity behavior between groups. Cardinal and colleagues (2002) compared changes in physical activity levels in three groups. The intervention group attended a class on fitness, flexibility, diet, and stress. The control groups were a psychology class comprised of students who had previously completed the intervention class and a psychology class comprised of students who had never taken the intervention class. One possible explanation for the lack of difference between groups is that the intervention focused on increasing knowledge without providing activities that attempted to change behaviors in the students. Other possible explanations include seasonal effects of weather during the intervention time that could lead to failure to exercise and use of a self-report measure of physical activity, which could lead to recall bias.

In a different study, Cox and colleagues (2003) investigated the effects of fitness center-initiated exercise programs on energy expenditure and adherence among older women. Using home-based and fitness center-based groups, participants were further

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randomized into vigorously intense and moderately intense exercise groups. One major weakness of this study was that different methods were used to measure physical activity for each of the groups. The center-based group used heart rate monitors to determine energy expenditure, whereas the home-based group used self-report of heart rate. Additionally, both groups started their exercise program in a fitness center. The center-based group worked out in the center for 6 months whereas the home-based group worked out in the center for four sessions and then completed the program working out at home.

Goal Setting and Self-Monitoring

Several studies (Crouteau, 2004; Lombard et al., 1995; McKay et al., 2001; Nies et al., 2003; Swartz, Strath et al., 2003; Talbot et al., 2003; Wilde et al., 2001) found that combining goal setting with self-monitoring increased physical activity levels in both healthy adults and adults with chronic disease. Researchers had participants set goals to increase their pedometer step count goals by 10% to 30% over baseline steps (Crouteau, 2004; Talbot et al., 2003) or simply set a goal to walk 10,000 steps/day goal (Swartz, Strath et al., 2003; Wilde et al., 2001). Participants in Crouteau's (2004) study set more modest pedometer goals of 10% to 15% over their baseline steps, whereas Talbot and colleagues (2003) encouraged participants to set higher pedometer goals of 30% over their baseline steps. Wilde and colleagues (2001) studied ambulatory activity over a 4-day intervention. Participants were asked to walk at least 10,000 steps on 2 of the days and walk per their usual routine on the other 2 days. While most participants met the 10,000 step-goal on walk days, all women were less active on the days when a 10,000

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step-goal was not set. Pedometers used in conjunction with goal setting increased participants' daily ambulatory activity from 23% (Talbot et al., 2003) to 85% (Swartz, Strath et al., 2003).

Time spent in physical activity was the goal used in two studies (Nies et al., 2003; McKay et al., 2001). With a clearly defined goal of 90 minutes per week of walking, Nies and colleagues (2003) found that walking increased in women following a telephone-counseling intervention. However, McKay and colleagues (2001) observed that time-based goal setting and feedback did not help people with type II diabetes increase their physical activity level. Using an internet-mediated intervention, participants visited the Website less and less as the intervention continued.

Prompting and Social Support

Lombard and colleagues (1995) compared goal setting, self-monitoring, and feedback with social support with different frequencies and types of prompting. Researchers used five different groups and varied the intervention as to feedback (frequently or infrequently) used with or without goal setting and touching base (frequently or infrequently). They found that weekly prompting when combined with goal setting, self monitoring, and social support increased adherence to walking behavior among the women who were members of the frequent feedback and goal-setting group.

Reinforcement

Powers-Noland (1989) studied the relationship between self-monitoring, reinforcement, and amount of physical activity. She found that the self-monitoring and reinforcement groups increased exercise more than the control group.

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Summary

In summary, this review of a-theoretically based physical activity interventions suggest that successful interventions focus on the importance of goal-setting, self-monitoring, social support, and reinforcement in making physical activity a part of one's lifestyle. All but three studies used a research design that randomly assigned participants into groups; the three studies (Crouteau, 2004; Oja et al., 1998; Wilde et al., 2001) did not use control groups in their design. Unsuccessful interventions suffered from problems with intervention content (Cardinal et al., 2002), delivery (McKay et al., 2001), or a lack of focus on behavioral factors and lifestyle physical activity (Cox et al., 2003). Other design issues that may have reduced statistical power in all of these studies are small sample size, unequal groups, and self-report measures of physical activity.

Studies That Used Theory-based Interventions

Biddle and Nigg (2000) emphasize that although a-theoretical approaches are often used in descriptive studies of physical activity, theoretical approaches are recommended for physical activity intervention studies. Intervention studies based on theoretical models assist researchers to identify and focus on variables that are highly related to physical activity (Sallis & Owen, 1999); increase the knowledge and understanding of the motivation behind people's physical activity level (Biddle & Nigg, 2000; Tudor-Locke, Myers, & Rodgers, 2001); and determine the content of the intervention (Conn, Rantz, Wipke-Tevis, & Maas, 2001). Pender's Health Promotion Model (HPM) (Pender, Murdaugh, & Parsons, 2002), the Transtheoretical Model (TTM) (Prochaska & Velicer, 1997), and Social Cognitive Theory (SCT) (Bandura, 1986) are

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among the most common behavior change theories used in physical activity intervention studies (Sallis & Owen, 1999). Studies that used behavior change theories are summarized in the next section.

Studies That Used the Health Promotion Model

Physical activity levels did not increase in two intervention studies (Barrett, 2000; Frenn et al., 2003) that used the Health Promotion Model (HPM). HPM integrates expectancy-value theory, Social Cognitive Theory, correlates from empirical studies, and a nursing perspective of human functioning to direct the development of interventions to change behavior (Pender et al., 2002). The constructs of the model include individual characteristics and experiences, perceived benefits and barriers, self-efficacy, activity-related affect, interpersonal influences, situational influences, commitment to a plan of action, and immediate competing demands and preferences. Frenn and colleagues (2003) used a combination of internet and video exercises to deliver a diet and physical activity intervention to middle-school students. The intervention included concepts from HPM, such as identification of participants' benefits and barriers to physical activity, self-efficacy, and situational influences (operationally defined as access). Their study suffered from a high attrition rate (65%) in the sample. Barrett (2000) used the internet to deliver a walking intervention to middle-aged White women. She used a comparison group that received some physical activity information instead of a control group. Self-report measures rather than an objective measure of physical activity behavior were used in both studies with no significant differences in physical activity behavior between the groups.

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Studies That Used the Transtheoretical Model

The Transtheoretical Model (TTM) was proposed by Prochaska and DiClemente in 1982 using constructs from the psychotherapy theories of Freud, Skinner, and Rogers (Prochaska & Velicer, 1997). The constructs of the model include stages of change, decisional balance, processes of change, self-efficacy, and temptation. Stages of change reflect not only the individual's current behavior but also intention toward behavior change. The five stages of TTM are precontemplation, contemplation, preparation, action, and maintenance (Prochaska & Velicer, 1997). Prochaska and Velicer (1997) define decisional balance as the weighing of benefits and barriers of behavioral change. Processes of change are activities used by individuals to adapt their experiences and/or environment to modify behavior (Marcus & Simkin, 1993). Individuals can choose from 10 different cognitive and behavioral processes. Research has linked certain processes to an individual's stage of change (Marcus & Simkin, 1993). Self-Efficacy is defined as "the situation-specific confidence people have that they can cope with high risk situations without relapsing to their unhealthy or high risk habit" (Prochaska & Velicer, 1997, p. 40). Temptation is defined as the intensity of urges to engage in a specific habit when in the midst of difficult situations (Hausenblas et al., 2001).

A number of physical activity intervention studies (Blissmer & McAuley, 2002; Dallow & Anderson, 2003; Hager et al., 2002; Kirk et al., 2001, 2003; Marcus, Bock et al., 1998; Marshall et al., 2003; Mutrie et al., 2002; Napolitano et al., 2003; Pinto et al., 2002; Woods et al., 2002) using TTM found that physical activity levels increased in the intervention groups. Of these studies, two (Marshall, Bauman et al., 2003; Pinto et al., 2002) found that relapse to sedentary lifestyles after 6 months increased significantly.

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Three studies (Loughlan & Mutrie, 1997; Marshall, Leslie, Bauman, Marcus, & Owen, 2003; Naylor, Simmonds, Riddoch, Velleman, & Turton, 1999) found no differences in physical activity level between intervention and control groups.

Interventions that were most successful in changing physical activity were those developed from the constructs of theory and tailored to an individual's stage of change (Dallow & Anderson, 2003; Kirk et al., 2003; Marcus, Bock et al., 1998; Napolitano et al., 2003). These interventions were individualized for each participant taking into account his or her readiness to change their behavior (stage of change), processes of change used most frequently by those in that stage, and self-efficacy. Strategies were matched to participants' stage of change in overcoming barriers to exercise.

Studies That Used Social Cognitive Theory

Social Cognitive Theory (SCT) states that the interaction of personal and environmental factors influences behavior (Baranowski, Perry, & Parcel, 2002). Constructs of the theory are internal personal factors, environment, and reciprocal determinism.

Previous research using SCT showed mixed results in increasing physical activity level. Classroom courses based on the concepts of SCT to promote physical activity resulted in weak or no behavior changes (Calfas et al., 2000; Elbel, Aldana, Bloswick, & Lyon, 2003; Ransdell, Dratt, Kennedy, O'Neill, & DeVoe, 2001; Sallis et al., 1999). Elbel and colleagues (2003) examined the difference between professional-led and peer-led classes on railroad workers' physical activity levels to determine if a supportive environment (social, institutional, physical) and one's self-efficacy could lead to greater

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physical activity levels. They found greater increases in physical activity in the peer-led group. However, the difference was not statistically significant. Sallis and colleagues (1999) used a 1-semester academic course to influence physical activity behavior in college seniors. Knowledge and skills were introduced through classroom work with additional assignments given to increase self-efficacy. To promote a social supportive environment, peer-led labs were developed to give participants practice at physically active behaviors. They found no differences in physical activity between an intervention or control group. Only females who were already active increased their physical activity levels. Calfas and colleagues (2000) performed a follow-up study exploring self-efficacy and physical activity with this sample. They found that the intervention failed to change self-efficacy within the participant. In a similar study (Ransdell et al., 2001), a structured classroom intervention developed for mothers and daughters found no change in the physical activity level of these females. However, feelings of physical self-perception were increased. Researchers in one study (Hallam & Petosa, 1998) taught employees in a worksite intervention about self-efficacy, outcome expectations, self-regulation, and physical activity. Although the researchers measured changes in the variables, they failed to measure changes in physical activity levels of the participants.

Physical activity intervention studies at home or using lifestyle physical activity based on SCT have been successful in increasing physical activity levels among adults. Physical activity levels were increased in both home-based and structured center-based physical activity intervention groups. These studies (Dunn, Marcus et al., 1999; Ransdell et al., 2002; Ransdell, Taylor et al., 2003) used self-study information packets containing strategies based on SCT, including how to identify and reduce barriers, self-regulation,

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and self-efficacy for home-based groups, and classroom presentations of the same information for center-based groups. Use of an internet-mediated physical activity intervention resulted in increased walking in women regardless of whether they were in the SCT-based intervention or education-only comparison groups (Whitely, 2001). Both groups had access to an internet site and the researcher also e-mailed messages. Messages to the SCT-based group were focused on self-regulation, identification of barriers, and self-efficacy. Messages to the education-only group were general tips, encouragement to walk, and encouragement to visit the Website. A home-based physical activity intervention was successful in increasing physical activity in mothers, daughters, and grandmothers (Ransdell, Robertson et al., 2004). Constructs of SCT were used to develop an intervention to increase lifestyle physical activity, aerobic fitness, muscular strength, and flexibility. The control group was asked to continue their usual activities.

Finally, a community-wide intervention (Pate et al., 2003) based on SCT aimed at 5^{th}- and 6^{th}-grade students failed to show a difference in physical activity behavior. Process evaluation revealed several problems with delivery of the intervention.

A major weakness of the above studies is that researchers often used self-report questionnaires rather than objective measures to determine physical activity level. A second weakness is that the majority of studies failed to determine mediating processes between the theoretical variables within SCT and the intervention outcome.

Studies That Used Other Theory-Based Interventions

The Theory of Planned Behavior (TPB) and Transtheoretical Model (TTM) were used to develop mass media messages to promote walking in Wheeling, West Virginia

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(Reger et al., 2002). The TPB states that an individual has control over factors that either inhibit or promote their behavior (perceived behavioral control). Paid advertisements, public relations activities, and a Website were used to educate elderly citizens in this community about physical activity. Additionally, worksite, faith-based, and civic-based programs presented skills to participants on barrier identification and problem-solving strategies used to promote walking activity. Physicians wrote "prescriptions for walking" for their elderly patients. Elderly adults from a nearby community were used as a comparison group. Physical activity was measured by observation of activity in the park and each citizen provided a self-report of activity. When compared to the community not receiving the intervention, walking increased significantly (23%) in the intervention community.

Two studies used lesser-known models of health behavior change. Women significantly increased their walking behavior during an intervention when the Conceptual Model for Maintenance of Physical Activity in Women (Speck & Looney, 2001) was used. Developed by Speck (2001), this model combines Social Cognitive Theory with psycho-social-physiological variables and past and current levels of activity for use in developing interventions to promote behavior change. The Model of Client Health Behavior was used in a study by Wilber and colleagues (2001) to develop an intervention to facilitate adherence to a walking program for women. However, constructs of the model were not given. Women showed good adherence to intensity and duration (>90%) but less adherence to frequency (66%) in their walking program. These findings suggest that women had difficulty in finding the time to walk. In addition, 77% of the women who began the study were still walking at the end of 6 months.

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A summary of literature related to the theoretically-based studies designed to increase physical activity level is presented in Appendix A. Each study; sample size and characteristics; purpose and design; and measures of outcomes, findings, and limitations are presented. Because behavior change theories determine the content of interventions, the next section will describe the theory used for this study.

Theoretical Framework—Social Cognitive Theory (SCT) of Behavior Change

The framework for this study is the Social Cognitive Theory (SCT) of Behavior Change (Bandura, 1986). SCT states that behavior can be changed because of personal factors and environmental influences that all interact with each other (Baranowski et al., 2002). This theory was chosen because of the emphasis on rewarding positive (healthy) behavior rather than extinguishing negative (unhealthy) behavior. Additionally, the specific strategies proposed by stage theories that cause movement from one stage to another are inconsistent (Weinstein, Rothman, & Sutton, 1998). SCT has been used to structure interventions that promote physical activity. The theory consists of four major constructs: (1) internal personal factors, (2) environment, (3) reciprocal determinism and (4) behavior (Figure 1).

Internal Personal Factors

Internal personal factors include behavioral capability, self-efficacy, outcome expectations, and self-control (self regulations). Behavioral capability is defined as the knowledge and skills an individual needs to perform a behavior. Self-Efficacy is defined as the self-confidence in performing and in overcoming barriers that prevent performing a

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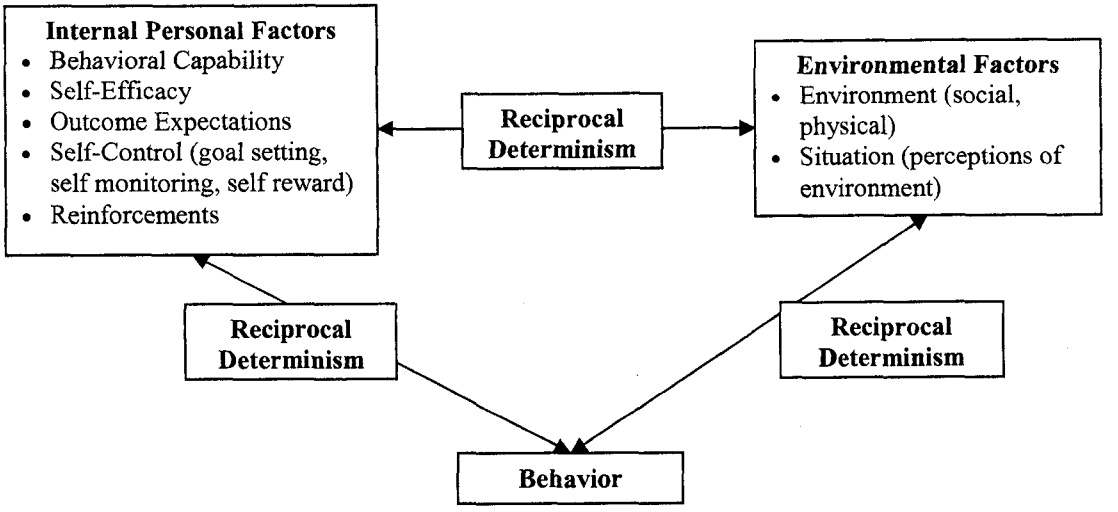

Figure 1. Bandura's Social Cognitive Theory.

particular behavior (Baranowski et al., 2002). Outcome expectations are defined as the outcomes an individual expects will occur because of a behavior. Self-control is defined as the self-regulation of behavior. Self-regulations are enhanced by the ability to (1) set goals, (2) monitor progress toward the goals, (3) give rewards for attaining goals, and (4) identify and solve problems. It has been suggested that outcome expectations and self-efficacy are critical to the success of behavior change (Keller, Fleury, Gregor-Holt, & Thompson, 1999).

Environmental Factors

Environmental factors include social, institutional, and physical characteristics that are external, not a part of their internal behavioral factors, to the person (Baranowski et al., 2002) and are classified as environment and situation. Environment refers to objective characteristics that affect a person's behavior but are not internal personal

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factors. These can be social or physical. Examples of the social environment include family, friends, co-workers, and peers. Examples of the physical environment include weather patterns, access to safe exercise areas, and vicious dogs. Situation refers to how the individual perceives the environment; it may be real, distorted, or imagined. Incorrect perceptions about one's environment may increase barriers to the desired behavior.

Reciprocal Determinism

Reciprocal determinism is the interchange between an individual's behavior and the environment (Baranowski et al., 2002). Both the individual's behavior and the environment influence and are influenced by each other. No studies to date have measured reciprocal determinism perhaps because of its complexity and dynamic nature.

Intervention Delivery Method

Recent research (Dishman & Buckworth, 1996; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998; Marshall et al., 2004) shows media-based interventions that combine media approaches may be as effective as face-to-face interventions. To date, 14 studies have used media-based interventions that included mailing print materials (Bock, Marcus, Pinto, & Forsyth, 2001; Marcus, Owen et al., 1998; Marshall, Bauman et al., 2003; Mutrie et al., 2002; Woods et al., 2002); internet and video (Frenn et al., 2003), e-mail messages (Barrett, 2000; Hager et al., 2002); telephone counseling (Nies et al., 2003; Pinto et al., 2002); a Website on physical activity (McKay et al., 2001; Napolitano et al., 2003; Whitely, 2001); and a mass media campaign using paid advertisements, public relations activities, walking programs, and a Website (Reger et al., 2002). Because these

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studies were previously summarized and are not the focus of this study, only those studies related to use of the internet will be discussed further.

Internet Interventions

Interventions using Web-based promotion of physical activity show mixed results in increasing physical activity levels (Barrett, 2000; Hager et al., 2002; Marshall, Leslie et al., 2003; McKay et al., 2001; Napolitano et al., 2003; Whitely, 2001). E-mails used to encourage participants to walk increased physical activity levels in one study of adults (Hager et al., 2002); however, in another study, there were no significant differences in physical activity levels of adult women between a control group and group that received e-mail reminders (Barrett, 2000). However, weather may have been a factor in the outcome of these studies. Barrett (2000) conducted her intervention in Boston, MA, during late winter and early spring, whereas Hager and colleagues (2002) conducted their intervention in Provo, UT, during March and April. Additionally, the type of messages sent by e-mail varied between the two studies. Although both studies used the Transtheoretical Model's stages of change to tailor messages, Hager and colleagues sent many more suggestions to participants on how to increase their physical activity than Barrett.

Two studies (McKay et al., 2001; Whitely, 2001) that used physical activity Websites found no group differences or decreases in physical activity levels of adults. McKay and colleagues (2001) found that participants' use of the Website and participation in physical activity decreased as the intervention continued over the 8-week

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study period. In a similar study, Whitely (2001) found increases in physical activity in both the intervention and information-only control group.

In contrast, Napolitano and colleagues (2003) successfully encouraged participants in the intervention group to walk using a physical activity Website. Another study (Marshall, Leslie et al., 2003) found no differences between groups who received print materials and those who logged onto a Website to deliver physical activity information. Although there were no statistical differences in physical activity between these groups, time spent sitting was significantly reduced in the Web group.

One possible explanation for the variety of results in these studies was use of self-report measures to determine physical activity levels. Additionally, one study (McKay et al., 2001) did not ground their intervention in theory. Only three studies (McKay et al., 2001; Napolitano et al., 2003; Whitely, 2001) performed some type of process evaluation to determine if the intervention was delivered to the participants as planned. Because process evaluation is an important component of any successful intervention, the next section will describe steps for successfully conducting a process evaluation.

Process Evaluation

Process evaluation is an evolving methodology in physical activity research that has been used in program evaluation to measure and analyze factors that may affect an intervention's implementation (Bauman, Sallis, Dzewaltowski, & Owen, 2002). Defined as "a form of program monitoring designed to determine whether the program is delivered as intended to the target recipients" (Rossi et al., 2004, p. 64), process evaluations help explain positive, modest, and insignificant results (Stechler & Linnan,

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2002). Process evaluations give important information about the cause of an intervention's success or failure. This information provides rationale to improve interventions and thus improve public health.

The purpose of a process evaluation is to evaluate how and why an intervention works, including mechanisms of change or mediating processes (Baranowski & Stables, 2000; Sidani & Braden, 1998; Stechler & Linnan, 2002). Whereas this strategy once involved only quality assurance, the functions of process evaluation have evolved to include demonstration of consistency of the intervention; surveillance of the intervention to correct problems as they occur; and data generation to examine the relationship between the intervention, mediating variables, and outcomes of the program (Baranowski & Stables, 2000; Sidani & Braden, 1998; Stechler & Linnan, 2002). Wagner and Guild (1989) claim that process evaluation examines the effectiveness of recruiting participants into programs as well as the staffs' ability to adhere to program objectives.

As previously noted, the components of process evaluation vary. Clearly, this lack of specific, consistent definition of the components is a gap in current knowledge of process evaluations. Table 1 presents the components and definitions of process evaluation used by different authors. Sidani and Braden (1998) give eight examples of elements found in a process evaluation, Stechler and Linnan (2002) present seven components, and Baranowski and Stable (2000) list 11 components. Bold type indicates components that are advocated as part of process evaluation by all three authors.

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Table 1

Components of Process Evaluation

Component	Sidani & Braden (1998)	Stechler & Linnan (2002)	Baranowski & Stables (2000)
Barriers—problems encountered in reaching participants (Baranowski & Stables, 2000)			X
Contamination—extent to which participants received interventions from outside program; extent to which control group received treatment (Baranowski & Stables, 2000)			X
Context—aspects of larger social, political, and economic environment that may influence intervention implementation (Baranowski & Stables, 2000)		X	X
Continued Use—extent to which participant continued to do any of the activities (Baranowski & Stables, 2000)			X
Dose Received—extent to which participants actively engage with, interact with, are receptive to, and/or use materials or recommended resources; assesses extent of engagement of participants with intervention (Stechler & Linnan, 2002)	X	X	
Exposure/Dose Delivered—extent to which participant viewed or read materials that reached them (Baranowski & Stables, 2000)	X	X	X
Fidelity—extent intervention was delivered as planned; represents quality and integrity of the intervention as conceived by developers (Stechler & Linnan, 2002)	X	X	

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Table 1 Continued

Component	Sidani & Braden (1998)	Stechler & Linnan (2002)	Baranowski & Stables (2000)
Implementation—degree to which intervention was put into action as designed (Baranowski & Stables, 2000; Stechler & Linnan, 2002)	X	X	X
Initial Use—extent participant conducted activities specified in materials (Baranowski & Stables, 2000)			X
Maintenance—keeping participants involved in programmatic and data collection aspects of program (Baranowski & Stables, 2000; Stechler & Linnan, 2002)		X	X
Mediating Process—acts of factors that influence behavioral changes (Bauman, Sallis, Dzewaltowski, & Owen, 2004; Sidani & Braden, 1998)	X		
Reach—percentage of intended targeted participants that enroll and take part in an intervention; often measured by attendance (Baranowski & Stables, 2000; Stechler & Linnan, 2002)	X	X	X
Recruitment—procedures used to approach and attract participants. (Stechler & Linnan, 2002)	X	X	X
Resources—materials or characteristics of agencies, implementers, or participants necessary to attain goals (Baranowski & Stables, 2000)	X		X

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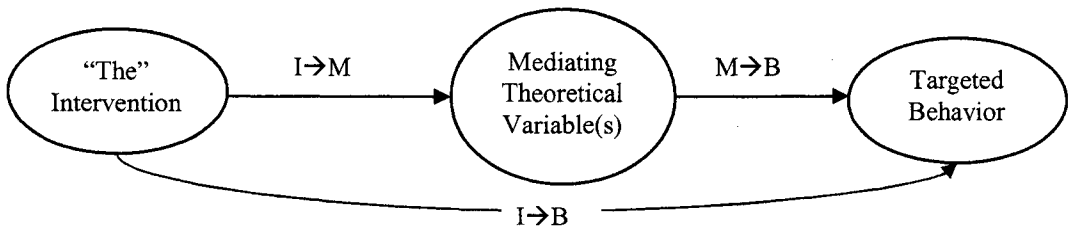
Within the components of process evaluation, the assessment of mediating processes determines variables that influence behavioral changes (Bauman et al., 2004; Sidani & Braden, 1998). The mediating mechanism model is one method used to determine the degree to which mediating variables (theoretical constructs) explain the intervention outcome or behavior change (Baranowski, Anderson & Carmack, 1998). The mediating mechanism model states that the intervention affects changes both directly and through mediating variables to cause a behavior change (Figure 2) (Baranowski et al., 1998).

Researchers are being encouraged to examine mediating variables derived from theory in the design, implementation, and evaluation of interventions. While behavior change is thought to occur through interaction with variables based on theoretical constructs, there is little evidence that suggests that these variables alone cause substantial change in the intervention outcome.



Mediating variables = Theoretical constructs
I = Intervention
M= Mediating variable
B= Behavior

Source: Baranowski, T., Lin, L. S., Wetter, D. W., Resnicow, K., & Hearn, M. D. *Community interventions. Why aren't they working as desired: The issue of mediating mechanisms.* Available at http:// www.nih.gov. Accessed May 20, 2004. Reprinted with permission.

Figure 2. Mediating mechanism model.

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Studies That Included Process Evaluations of the Intervention

Although most previous research on physical activity interventions has overlooked the importance of process evaluations, there have been recent notable exceptions. Several studies (Lee et al., 1997; Linnan et al., 2002; Sarkin, Marshall, Larson, Calfas, & Sallis, 1998; Saunders, Greaney, Lees, & Clark, 2003; Yancey et al., 2001) compared methods of recruiting and maintaining participants. Other studies examined program implementation (Pate et al., 2003; McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001), dose received (McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001), and intervention fidelity (Pate et al., 2003, Ransdell, Oakland, & Taylor, 2003).

Context Evaluation

Although context evaluations can determine if social, cultural, or physical environmental factors affected intervention, the context in which an intervention occurs is rarely assessed. For example, if the physical environment does not have sidewalks in good repair or trails designated for walking, interventions that encourage participants to walk may fail. Gender issues related to physical activity are important to assess before, during, and after an intervention (Belza & Warms, 2004). Some issues that women are concerned with include problems with childcare and urinary incontinence. The value women give to exercise and how acceptable it is to spend time away from the family to exercise also can affect their motivation to exercise.

One nonintervention study investigated whether or not social factors within neighborhoods affected physical activity levels (Lee & Cubbin, 2002). Whereas

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neighborhood characteristics, such as poverty, education, and family income level, were not associated with physical activity participation, lower individual socio-economic status was correlated with a decrease in physical activity (Lee & Cubbin, 2002).

Although context was not the focus of a process evaluation by Pate and colleagues (2003), they found that social and cultural behaviors resulting from strong rivalries between communities interfered with the success of a physical activity intervention with 5th- and 6th-grade students. These rivalries led to discipline problems among participants; resolving these problems took time away from the intervention.

Recruitment and Maintenance Evaluation

Recruitment and maintenance of study participants can affect statistical power (Baranowski & Staples, 2000), external validity (Baranowski & Staples, 2000; Dzewaltowski, Estabrooks, Klesges, Bull, & Glasgow, 2004; Grant & DePew, 1999), and success of the intervention (Grant & DePew, 1999). Recruitment methods can be either active or passive and include the use of media, telephoning, and incentives (Grant & DePew, 1999).

Active and passive recruitment were operationally defined differently among the studies making it difficult to compare results. In general, active recruitment involved the researcher targeting and asking participants to enroll in a study; whereas, passive recruitment involved participants seeking out and asking the researcher to enroll them in a study. Examples of active recruitment techniques used in studies consisted of telephoning (Lee et al., 1997), direct mailings to targeted potential participants (Lee et al., 1997; Sarkin et al., 1998; Yancey et al., 2001) and face-to-face contact in public places

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with sign-up sheets (Lee et al., 1997; Linnan et al., 2002; Yancey et al., 2001). Examples of passive recruitment methods used were varied with two studies (Lee et al., 1997; Yancey et al., 2001) using mass media and social networking techniques (Yancey et al., 2001). Mass media approaches included newspaper ads, flyers, and radio announcements, whereas social networking was described as disseminating information about the study through word of mouth and brief announcements at meetings. Direct mailings were considered as either passive or active techniques. Three studies (Lee et al., 1997; Sarkin et al., 1998; Yancey et al., 2001) sent letters containing the researcher's phone number asking interested participants to call and sign up for the study. Sarkin and colleagues (1998) sent two different letters to all potential participants describing the study with one letter asking interested participants to call for enrollment (active); recipients of the second letter were later contacted by the researchers to ask participants if they would like to enroll in the study (passive). After sending a letter describing the study, one group of researchers (Linnan et al., 2002) used a company-generated telephone list to contact all potential participants as a passive method of recruitment. Therefore, results of these studies must be viewed with caution as announcements at meetings and direct mail were considered active recruitment methods in some studies and passive recruitment methods in others.

Overall, passive methods were more efficient in recruiting participants than active methods (Lee et al., 1997; Sarkin et al., 1998; Yancey et al., 2001). Flyers and word-of-mouth were the most effective methods used. One study (Linnan et al., 2002) found that active recruitment was more effective than passive methods; however, the results differed from other studies because definitions of active and passive recruitment were opposite

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from the other studies. Whereas active recruitment was defined in three of the studies (Lee et al., 1997; Sarkin et al., 1998; Yancey et al., 2001) as researchers asking potential participants to take part in the study, Linnan and colleagues (2002) defined active recruitment as potential participants asking researchers to take part in the study. Passive recruitment was defined in three of the studies (Lee et al., 1997; Sarkin et al., 1998; Yancey et al., 2001) as potential participants seeking out researchers and asking to become a participant, whereas Linnan and colleagues (2002) defined passive recruitment as researchers seeking out potential participants and asking them to take part in the study.

In addition to defining the variables differently, Linnan and colleagues (2002) used passive recruitment strategies for both groups. All potential study participants attended recruitment events at their worksite and were exposed to incentives, promotional flyers, posters, and notices before recruitment into the study began. Once the worksite was designated as either active or passive, employees were mailed letters asking for participation in the study. Participants in the actively recruited group were telephoned only if they returned part of the letter which included the researchers' telephone number, whereas all of the participants in the passively recruited group were telephoned individually and asked to participate. Both groups were briefly exposed to the purpose, significance, and time needed to participate in an upcoming study and then, as previously described, active or passive recruitment methods were used to enroll participants into the study. It appears that passive recruitment measures were more effective than active recruitment measures in light of these limitations.

Maintenance and retention may be increased when study participants are informed of the significance, risks and benefits, and contributions to society of the study

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(Grant & DePew, 1999). The time and commitment required of participants also is important to communicate (Grant & DePew, 1999). Two studies (Linnan et al., 2002; Sarkin et al., 1998) found that those who were passively recruited tended to remain in the study more than those actively recruited. Sarkin and colleagues (1998) attribute the higher attrition rate in the actively recruited group to researchers' failure to emphasize the importance of and purpose of the study to the participants. In contrast, although passive recruitment was more efficient in recruiting participants into the study, active recruitment retained more participants (Lee et al., 1997).

Establishing relationships with key individuals, or gatekeepers, can be beneficial in recruiting participants (Grant & DePew, 1999). One study (Saunders et al., 2003) used contacts with community partners to help recruit senior citizens from two different communities into an intervention study. Although recruitment took longer to coordinate, the researchers were able to recruit a more representative sample, including members of an ethnic group previously not reached by researchers.

In summary, recruitment and maintenance of study participants influences statistical power, generalizability of the results, and the success of the intervention. Assessments of methods used to recruit and maintain participants are needed to facilitate the development of effective methods to attract and retain representative samples for intervention studies.

Program Implementation

Implementation was the most common component evaluated in studies that included process evaluations (Pate et al., 2003; Leslie, Marshall, Owen, & Bauman,

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2005; McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001). Physical activity interventions were not successful when planned program aspects were not put into practice (Pate et al., 2003), participants did not access or engage in using the Website to receive the intervention (Leslie et al., 2005; McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001), or participants did not attend the intervention (Pate et al., 2003). Barriers for intervention implementation were lack of time (Sciamanna et al., 2002; Whitely, 2001), occurrence of physical problems that prevented walking (Whitely, 2001), and perception that intervention material was not helpful or useful (McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001). Leslie and colleagues (2005) offered suggestions that may enhance engagement such as encouraging home access to the Website rather than work access, interactive sites that require making and submitting goals and logging activity, and brief face-to-face contact to introduce the site to users. These findings suggest that developers of interventions need to find ways to attract participants to use the Website and reduce barriers to both using the Website and walking.

Intervention Fidelity

In addition to how well the intervention was implemented, interventions grounded in behavior change theories and previous characteristics of successful physical activity interventions had fidelity to the underlying theory as determined by experts reviewing the intervention (Pate et al., 2003; Ransdell, Oakland et al., 2003). Theoretical integrity and suggestions from focus groups were used by Ransdell, Oakland et al. (2003) to refine their intervention. They state that focus group input appeared to increase participant acceptance and success of the intervention.

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Mediating Variables

Although many of the previous studies measured variables from SCT, few studies examined the mediating effects of these variables. Interventions are successful when the intervention produces changes in outcome behavior and in the mediating variable. Finally, the mediating variable must produce a change in outcome behavior (Baranowski, Lin, Wetter, Resnicow, & Hearn, 1997).

Mediation analysis should only be performed when interventions were successfully implemented and showed a behavior change (MacKinnon, 1994). These successful interventions work by changing the variable, such as self-efficacy, that produces the behavior change (Baranowski et al., 1997). Therefore, it is important to determine if the intervention was successful in changing both behavior and mediating variables.

Of the intervention studies that produced a behavioral change, significant increases were reported in self-efficacy (Brassington et al., 2002; Hallam & Petosa, 2004; Miller et al., 2002) and outcome expectations (Brassington et al., 2002; Hallam & Petosa, 2004). One intervention (Brassington et al., 2002) explained only 14% of the variance of self-efficacy and 5% of the variance of outcome expectations. Therefore, this intervention should be redesigned to cause greater changes in outcome expectations in the participant. Although Garcia and King (1991) showed their intervention was effective in increasing adherence to physical activity, they did not determine if self-efficacy was changed as a response to the intervention. Three studies (Calfas et al., 2000; Elbel et al., 2003; Whitely, 2001) found that the intervention was unsuccessful in changing physical activity

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behavior. As expected, self-efficacy and outcome expectations did not change because of the interventions. Therefore, one might assume that these interventions were weak in efforts to create changes within these variables and, thus, behavior. Another possibility for these results is that self-efficacy and outcome expectations are not key variables to behavior change.

Finally, it is important to determine if the mediating variable causes a change in behavior and how much of the change in behavior can be explained by the mediating variable. A mediator that explains 70% of the variance in the outcome is considered more successful than one that explains only 20% of the variance in the outcome (Baranowski et al., 1997). Studies on the mediating effects of self-efficacy have had mixed results. While self-efficacy mediated the intervention in two studies (Brassington et al., 2002; Miller et al., 2002), it failed to mediate the intervention in another (Hallam & Petosa, 2004). Three studies reported that self-efficacy accounted for 13% (Prodaniuk, Plotnikoff, Spence, & Wilson, 2004), 17% (Garcia & King, 1991), and 21% (Brassington et al., 2002) of the variance in exercise. Most importantly, almost 75% of the variance was explained by variables other than self-efficacy. Keller and colleagues (1999) theorized that individuals attempting difficult changes in behavior need higher levels of self-efficacy. With this in mind, it is important to determine the mediating effects of this variable.

In a nonintervention study, self-efficacy was found to directly mediate physical activity only slightly (Rovniak, Anderson, Winett, & Stephens, 2002). However, when self-efficacy was mediated through self-regulation, it was a strong mediator of physical activity behavior. The more able an individual was able to set goals, plan and monitor

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activity, and solve problems related to barriers, the greater his or her level of physical activity.

Outcome expectations typically do not act as mediators to physical activity (Brassington et al., 2002; Hallam & Petosa, 2004; Prodaniuk et al., 2004; Rovniak et al., 2002). The findings concerning outcome expectations may be related to the second assumption of mediation analysis that instruments must have high reliability. Statistical power is reduced when instruments used to measure mediating variables do not have high reliability (MacKinnon, 1994). While self-efficacy instruments are typically valid and reliable, instruments to measure outcome expectations are less developed. Neff and King (1995) developed an expected benefits questionnaire to measure outcome expectations in older adults. Factor analysis showed two factors: psychological/behavioral benefits and perceived physical fitness. These authors failed to report internal consistency reliability coefficients for this tool; however, Whitely (2001) reported coefficient alphas of .90 and .83 in her sample of middle-aged women. Steinhardt and Dishman (1989) developed and refined an outcome-expectancy values scale through factor analysis. Nineteen items were isolated when the instrument was tested with college students, and three factors were identified: psychological, body image, and health. Test-retest reliability correlations of the instrument were .66 to .89 and Cronbach's alpha of internal consistency coefficients ranged from .47 to .78.

In summary, it was difficult to compare results of these studies because of the inconsistent manner in which components of the process evaluation were defined. Context was often overlooked in evaluating interventions. Although active and passive recruitment were studied, difficulties in operationally defining the concepts have led to

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confusion about the results. For example, it was not only challenging to interpret the combined findings of these studies (Lee et al., 1997; Linnan et al., 2002; Sarkin et al., 1998; Yancey et al., 2001), but also to identify concrete examples of active and passive techniques. Physical activity interventions were not successful when they were inadequately put into practice (Pate et al., 2003), attendance was low (McKay et al., 2001; Pate et al., 2003; Sciamanna et al., 2002; Whitely, 2001), or the intervention inadequately reflected the theory (e.g., intervention did not target change through the theoretical variables) (Calfas et al., 2000; Elbel et al., 2003; Whitely, 2001). A summary of literature related to process evaluations done with physical activity interventions is presented in Appendix A. Each study; sample size and characteristics; purpose and design; and measures of outcomes, findings, and limitations are presented.

Summary

Prior intervention studies have lacked three things: (1) they were not based on a behavior change theory; (2) process evaluations to determine how participants were recruited into and encouraged to remain in the intervention were not conducted; and (3) within process evaluations, mediating variables that increase success of outcome with the participants, were not evaluated. Most significant, perhaps, was that few studies measured physical activity using objective measures (i.e., pedometer) or a combination with other methods to determine physical activity level.

The traditional means by which behavior is modified in college-aged students is by offering formal coursework. However, colleges in today's money-stretched environment do not choose to stipulate "physical activity promotion classes" as a

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requirement of graduation. Internet-mediated education is appealing to college-aged students (Jones, 2002); therefore, internet-mediated approaches to promote physical activity should be investigated to increase moderately intense physical activity, especially walking. Investigation and evaluation of internet-mediated, theory-based interventions to promote moderately intense physical activity should be explored to determine efficacy in promoting physical activity. If these programs work, the mechanisms through which they work (mediators) need to be established. Additionally, knowledge of participant's attitude toward the intervention will facilitate further intervention development. Internet-mediated interventions reach large numbers of participants on a low cost basis which may influence women and other underserved communities to increase physical activity levels.

In conclusion, physical activity can prevent heart disease, osteoporosis, diabetes, and some cancers. Unfortunately, physical activity declines in women in the years between college and career. Few intervention studies have targeted this group for changing physical activity levels. Therefore, college-aged women are a high-risk group that should be targeted for promotion of physical activity. Concepts from Social Cognitive Theory and an objective measure of physical activity were used to develop a physical activity intervention delivered via the Internet to encourage moderately intense physical activity, such as walking, in college-aged women and a process evaluation was performed to determine how and why the intervention was effective.

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CHAPTER III

METHOD

Design

An experimental repeated measures design using three groups was proposed to determine the efficacy of delivering a 4-week physical activity intervention by Web-based media (Web-CT) to college-aged females and to explore if self-efficacy was a mediator. Dishman and Buckworth (1996) found that interventions of moderately intense physical activity, delivered through mediated methods, and shorter lengths (4 to 6 weeks) had higher effect sizes. The data were used to determine if a 4-week physical activity intervention using Social Cognitive Theory and administered via the internet to college-aged females increased lifestyle physical activity.

To obtain baseline ambulatory activity, all participants wore a sealed pedometer for 7 days and completed one self-administered instrument. After random assignment to an intervention or control group, participants in the control group were further divided into two groups: one group wore a sealed pedometer during the 4-week intervention period and one group wore an unsealed pedometer during the 4-week intervention period. This was done to differentiate between changes in physical activity level from the exposure to the intervention or the motivating effect of wearing a pedometer. The sealed-pedometer group met with the researcher weekly to have the steps recorded and the

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pedometer reset. Participants in the unsealed-pedometer group recorded the steps taken and time pedometer was worn each day for the 4 weeks. Finally, both control groups completed the self-administered instrument at the end of the intervention period. Control group participants were given the opportunity to participate in the intervention after the control period.

After baseline ambulatory activity was obtained as previously described, participants in the intervention group participated in a Web-based intervention where they learned about lifestyle physical activity, set step goals and wore a pedometer to monitor the attainment of the step goal, recorded daily steps taken, and participated in a process evaluation of the intervention. Last, they completed the self-administered instrument at the end of the intervention.

A process evaluation of the intervention was conducted. This evaluation consisted of quantitative and qualitative data collection techniques to evaluate whether or not the intervention was effective in reaching the intended target and factors that influenced its success or failure. The components of process evaluation that were used in this study were context, recruitment, maintenance, and mediating processes. These components were chosen because context issues related to physical activity are important to women (Belza & Warms, 2004; Grubbs & Carter, 2002; Jaffe et al., 1999; Ransdell, Vener et al., 2004); recruitment, engagement, and retention of participants are significant challenges for Web-mediated interventions (Marshall, Owen et al., 2004); and mediating variables, derived from theory, should be examined to determine if these variables alone cause substantial change in the intervention outcome (Baranowski et al., 1998). Several authors suggest that triangulation of data collection methods, such as interviews, questionnaires,

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and observation, benefits studies by providing complementary information that helps to explain or clarify results obtained using experimental designs (Sandelowski, 2000; Sidani & Braden, 1998). Figure 3 diagrams the layout of this design:

Setting and Sampling

The setting for this study was the campus of Southern Utah University (SUU). SUU is a regional institution of higher education located in Cedar City and serves southern Utah. There are approximately 600 faculty and staff employed and 6500 students enrolled. Students come from all 29 counties in Utah, 44 states, and 21 foreign countries (Southern Utah University, 2002). The campus consists of the main campus, valley farm, mountain property, observatory, and an archeology site. Cedar City is close to two national parks, two national monuments, and Brian Head ski resort. Of the total enrollment, 55% of the students are female, 74% are single, and 92% are White. Ages of students range from 18 to over 39. Approximately 70% of all students live on campus or in apartments near the campus (Southern Utah University, 2002).

QUALITATIVE	← Continuous collection of both kinds of data →							
QUANTITATIVE	Intervention Group	R	$O_1^{\rightarrow}$	$X^{\rightarrow}$	$O_2^{\rightarrow}$	$O_3^{\rightarrow}$	$O_4^{\rightarrow}$	O_5
	Control Group	R-sp	$O_1^{\rightarrow}$		$O_2^{\rightarrow}$	$O_3^{\rightarrow}$	$O_4^{\rightarrow}$	O_5
		R-usp	$O_1^{\rightarrow}$		$O_2^{\rightarrow}$	$O_3^{\rightarrow}$	$O_4^{\rightarrow}$	O_5

Arrows indicate qualitative data collection took place throughout the study.

Key:

R	=	random assignment
O_1	=	baseline data collection
X	=	intervention
$O_{2\text{-}5}$	=	repeated times data collection
R-sp	=	random assignment to sealed pedometer group
R-usp	=	random assignment to unsealed pedometer group

Figure 3. Research design.

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Participants in this study were female, aged 18 to 34, were not considered physically active as determined by six researcher-developed questions, could walk unassisted, could follow directions, had the time and desire to participate, and reported feeling comfortable using computer technology on a short survey. Exclusion criteria included those females who were athletes at the university or majors in physical education or dance. Eligible students from SUU were enrolled into the study and randomly assigned to one of two groups: intervention and control. The control group was then randomly assigned to one of two groups: sealed pedometer and unsealed pedometer.

Sample size and power for the study were based on being able to correctly detect a significant difference in walking behavior (mean steps/day) between the intervention and control groups. Power analysis was based on using Repeated Measures Analysis of Variance (RM-ANOVA) using three groups (Web-CT Intervention, sealed pedometer control group, and unsealed pedometer control). A table from Stevens (2002) was used to determine sample size. Using an average correlation of .50, medium effect size of .35, level of significance of .05, and power of .80, at least 25 participants were recommended for each group ($n = 75$).

A second power analysis was performed to determine sample size needed to detect mediation effect between the intervention and the behavioral outcome. There are no power analysis routines available for mediation analysis (W. N. Dudley, Ph.D., personal communication, July 14, 2004). The first priority was to have enough power to detect the main effect of the intervention between the two groups; therefore, a power analysis for multiple regression using Power and Precision (Borenstein, Rothstein, & Cohen, 1997) was done. A medium effect size of .25, with a power of .80 and an alpha

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level of .05, indicated that 128 participants were needed for the study (64 participants for each group). The second priority was to have sufficient power to detect effects of the intervention on the mediator and the mediator on the outcome. Hoyle and Kenny (1999) emphasize that the ideal condition for statistical power shows less impact of the independent variable on the mediator (Path a) than impact of the mediator on the outcome (Path b) (Figure 4). A power analysis for multiple regression using Power and Precision (Borenstein et al., 1997) was done. A medium effect size of .50, with a power of .80, an alpha level of .05, and tails set at 1, indicated that 120 participants (60 participants per group) were needed for the study to detect effects of the intervention on the mediator (Path a: $r^2 = .08$). This sample would provide 97% power to detect the effect of the mediator on the outcome (Path b: $r^2 = .15$). The literature shows an r^2 of .14 for intervention's effect on the mediator (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002) and r^2 of .13 (Prodaniuk et al., 2004), .17 (Garcia & King, 1991), and .21 (Brassington et al., 2002) for the mediator effect on the outcome.

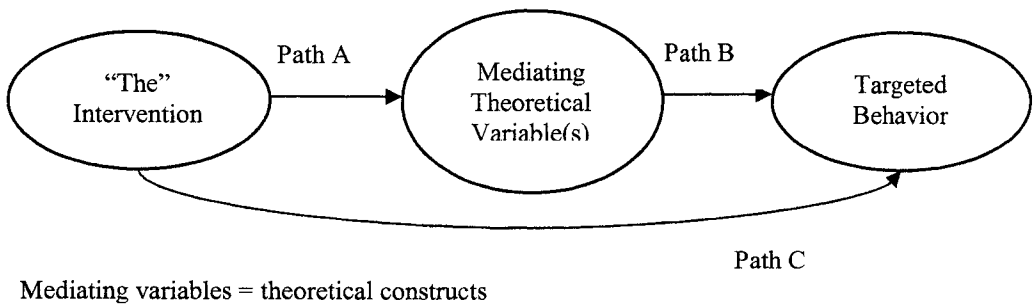

Figure 4. Pathways within mediating mechanism model.

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Since it is most important to have enough power to detect the main effect of the intervention between the two groups, 128 participants were the basis for determining power. Previous studies report attrition rates between 0% and 30% (Appendix A). Allowing for the possibility of attrition, sample size was increased by 10% to 142 (71 participants in each group, intervention and control).

Study Variables

Dependent Variable

The dependent variable was ambulatory activity as measured by mean steps taken per day. The Yamax SW-200 pedometer was used to measure ambulatory activity quantitatively as steps taken. This pedometer is a small, 2"x2", device worn on the belt or waistband (Bassett & Strath, 2002), and measures vertical body displacement with a spring-suspended lever arm that moves up and down with each step.

Independent Variable

The independent variable was the intervention. Interventions are defined as "treatments, therapies, procedures, or actions implemented by health professionals to and with clients in a particular situation to move the clients' condition toward health outcomes that are more beneficial to the client" (Sidani & Braden, 1998, p. 8).

Mediating Variable

The mediating variable was exercise self-efficacy. A mediating variable is defined as a theoretical construct that may influence the ability of a participant to change her/his behavior (Baranowski et al., 1998). The Exercise Self-Efficacy Scale was used to

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measure one's perceived confidence to overcome barriers to exercise (Appendix B). Developed by Garcia and King (1991), Hallam (1994) used factor analysis to analyze and develop the final set of items to consist of 15 items. Given the difficulties with the reliability of the tools to measure outcome expectations, appropriateness of these tools for college students, and lack of evidence that outcome expectations mediate behavioral change, outcome expectations were not examined as a mediating variable for this study.

Intervention

Delivery

The intervention was delivered using the Internet and an online program, Web-CT, which is used at SUU for academic purposes. I contacted participants who were randomized into the intervention group during the week of the baseline data collection. Web-CT training sessions were set up and conducted for each participant. Each training session was expected to take about 1 hour. Times for the training sessions were flexible so that participants could easily schedule them into their day. Participants were encouraged to access the Web-CT site daily.

Content

The 4-week intervention was created for Web-CT using the constructs of Social Cognitive Theory (Bandura, 1986). The following constructs of the SCT were used to develop modules: *behavioral capabilities, self-control, outcome expectations, self-efficacy, reinforcements, and environment and situation factors.*

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Behavioral Capabilities

Behavioral capabilities are defined as the knowledge and skills an individual needs to perform a behavior (Baranowski et al., 2002). Within this module, participants were introduced to the definition of lifestyle physical activity; how to integrate walking into their daily routine; and the benefits (outcome expectations) that accompany participating in physical activity. Stretching and safety tips for walkers were also presented. This module was introduced during the 1st and 2nd weeks of the intervention.

Self-control

Self-control is defined as the self-regulation of behavior (Baranowski et al., 2002). Self-regulation consists of the individual's ability to set goals, monitor progress toward meeting those goals, give rewards for attaining those goals, and identify and solve problems that may interfere with goal attainment.

Within this module, participants were introduced to the importance of setting goals and monitoring whether or not these goals are met. It was stressed that goals should be made that increase the amount of physical activity (walking) done by the participants. Rather than stress a goal of 10,000 steps/day, which some participants may not be able to meet, the module encouraged participants to write goals that initially increased their daily steps from 1000 to 3000 over their baseline steps. Personalized step goals were used to decrease the risk of failure to meet one's goal.

Participants were given pedometers at the beginning of the intervention and, through face-to-face interaction and reinforcement on the Internet, were instructed on how to wear and use the pedometer to record steps taken. This module reinforced the

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verbal and written instructions on pedometer use given at the beginning of the study. As a component of self-control, participants monitored their goal by recording pedometer steps taken daily. Weekly goals and pedometer steps were submitted by Web-CT to the researcher each week.

Additionally, this module contained information about the identification of barriers to physical activity and strategies to overcome these barriers. Questions were asked of the participants to identify barriers and how, or if, these were overcome so that they could meet their goal. Participants were encouraged to use this module throughout the intervention.

Self-Efficacy

Self-Efficacy is defined as self-confidence in performing and in overcoming barriers that prevent performing a particular behavior (Baranowski et al., 2002). Therefore, as one is able to overcome barriers to being physically active, one becomes more confident that one can increase physical activity level. One's self-efficacy is enhanced when one is allowed to make choices, have positive thought patterns, and demonstrate positive emotional coping responses. As mediation analysis requires larger sample sizes and Bandura (1997) has identified self-efficacy as the most important variable when making difficult changes in behavior, self-efficacy was the only variable investigated as a mediator. Within this module, participants were presented with choices and strategies to increase the amount of walking they do in their daily routine. Again, the process of identifying and dealing with barriers was reinforced because barriers cause many participants to stop their physical activity. Therefore, this topic was stressed in both

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modules to increase participant awareness. This module was introduced during the first week and emphasized during the 2nd and 3rd weeks of the intervention.

Reinforcement

Reinforcement is defined as strategies used to increase or decrease the likelihood of the behavior's reoccurrence (Baranowski et al., 2002). Although there was no module labeled *reinforcement,* this construct was operationalized by my giving individual feedback on performance attainment through personal e-mails and incentives given for the submission of goal statements and recording sheets (for steps/day) each week.

Environmental and Situational Factors

Environmental and situational factors are characteristics that are external to the person, meaning they are not a part of one's internal personal factors (Baranowski et al., 2002). Characteristics of *environmental factors* are defined as objective characteristics that affect a person's behavior but are not internal personal factors. These can be social or physical. Examples of the social environment include family, friends, co-workers, and peers. Examples of the physical environment include weather patterns, access to places to exercise, and vicious dogs. Characteristics of *situational factors* are defined as how the individual perceives the environment; perception may be real, distorted, or imagined. Environmental factors of the model were operationalized within this female-only intervention by encouraging walking with someone or in groups, making walking fun, making walking part of one's daily life, and providing links to maps, approximate step counts, and places to walk around the city.

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Short surveys at the end of each session were used to monitor positive or negative concerns about the intervention. Questions asked at the end of each module were: (1) How useful was the information in this module to you? and (2) Do you feel this module could be improved? If so, an e-mail address was given to the participants to send in suggestions. Table 2 identifies the constructs used in the intervention stating their definition and operationalization in the intervention. The structure of the intervention by Web-CT is illustrated in Figure 5. Self-Efficacy and its expression in the intervention is bolded to represent the proposed importance of this construct as a mediator to behavior change. The entire content of the intervention is contained in Appendix C.

Description

Once eligibility was confirmed using screening criteria (Appendix B), participants were enrolled into the study. They were randomly assigned to either the intervention or the control group.

After the initial data collection period, participants assigned to the control group were informed that they were in the control group and had been randomly assigned to either a sealed-pedometer group or unsealed-pedometer-and-recording-of-steps group. Participants in the sealed-pedometer group were given a pedometer and asked to wear it every day during the intervention. They were asked not to change their level of activity. The researcher met with them at the end of each week (Thursday-Thursday or Friday–Friday), unsealed the pedometer, recorded the steps taken, re-sealed the pedometer, and gave the pedometer back to the participant. Participants in the unsealed-pedometer group were given a pedometer and asked to wear it every day for the next 4 weeks (consistent

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Table 2

Developing the Intervention From Social Cognitive Theory

Construct	Definition	Intervention
Interpersonal Factors		
Behavioral capability	The knowledge and skills an individual needs to perform a behavior	Web-CT What is lifestyle physical activity and how to get started Safety Issues Benefits of physical activity
Self-control: set goals, monitor progress toward the goals, give rewards for attaining goals, and identify and solve problems.	The self-regulation of behavior	Web-CT Wearing and using a pedometer How to set goals Set goals to increase amount of physical activity each week; do not stress goal to be 10,000 steps but rather increase steps by 1,000 to 3,000 over baseline Monitoring your progress Record-keeping Goal submitted at beginning of every week and Recording Sheet of pedometer steps and time pedometer worn submitted at the end of every week Journaling Barriers to meeting goals identified and how, or if, these were overcome are addressed. Individual feedback on performance attainment (through e-mail or personal communication) Record-keeping Goal submitted at beginning of every week and Recording Sheet of pedometer steps and time pedometer worn submitted at the end of every week Journaling Barriers to meeting goals identified and how, or if, these were overcome are addressed. Individual feedback on performance attainment (through e-mail or personal communication)

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Table 2 Continued

Construct	Definition	Intervention
Self-Efficacy: choice, effort expenditure and persistence, thought patterns, emotional coping responses	The self-confidence one has in performing and in overcoming barriers that prevent performing a particular behavior (Baranowski et al., 2002)	Web-CT Choices and Strategies Give examples of how to increase walking and allow participant to choose options Strategies to deal with barriers Journaling Barriers to meet goals identified and how, or if, these were overcome addressed
Reinforcements	Strategies used to increase or decrease the likelihood of the behavior's reoccurrence	Use e-mail, Website, and telephone to keep participants informed Have rewards and/or incentives available for goal attainment Individual feedback on performance attainment through e-mails or personal communication
Environmental and Situational Factors		
Environmental	Objective characteristics that affect a person's behavior but are not internal personal factors (can be social or physical)	Female only environment Encourage walking in groups to increase safety Links Available on Web-CT sites that participants can walk during dark, inclement weather, etc; approximate step counts for trails, walking tracks, campus destinations, etc.
Situational	How the individual perceives the environment (may be real, distorted, or imagined)	Promote notion that physical activity can be of moderate intensity Promote philosophy that exercise is part of one's daily life (Lifestyle Physical Activity)

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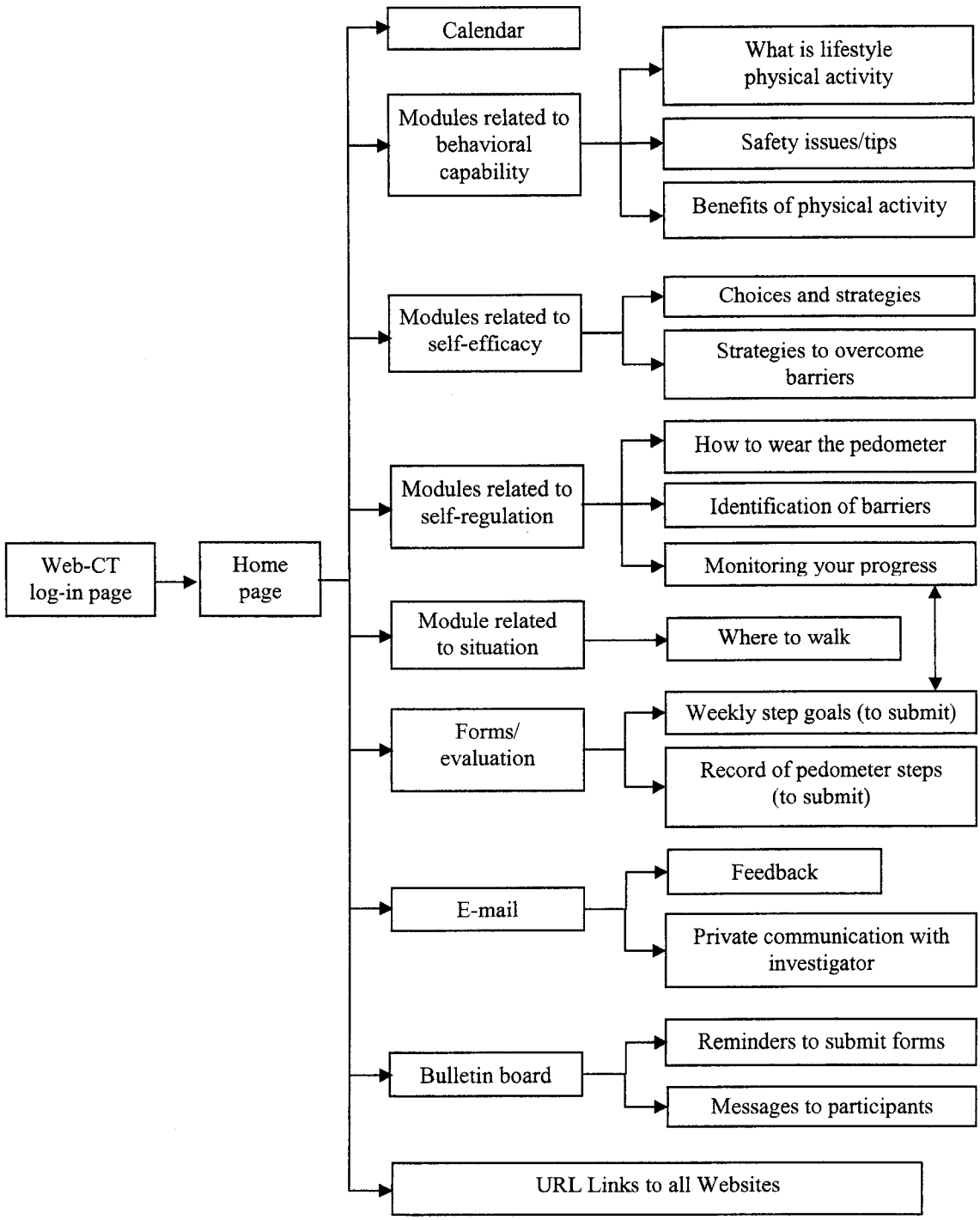

Figure 5. Web-CT intervention.

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with the intervention). They were asked not to change their level of activity. They were given a 4-week recording sheet in which to record their daily steps taken and times pedometer was worn (Appendix B). Participants in the control group were offered the opportunity to participate in the intervention at the end of the control period.

Participants assigned to the intervention group were scheduled for Web-CT training sessions. Topics for the training sessions included (1) logging into the system, (2) getting to the main directory, (3) content in each section, (4) moving from one section to another, (5) reading and sending e-mails and attachments, and (6) answering any questions students may have. In addition, participants were given their baseline mean steps from the previous week and shown how to set goals for walking for the 1st week of the intervention.

The 4-week intervention began at the end of the week (Friday to Friday). Participants were required to make and review their step goal for the current week by Thursday and submit it by Web-CT. A record of daily steps taken as recorded by the pedometer and times the pedometer was worn was submitted by Web-CT at the end of the week (Friday). This procedure was repeated each week throughout the 4-week intervention. Students were encouraged to log on to the Web-CT site daily, and read the different modules on the Web-CT site to help them develop their walking program. Messages to encourage visiting certain sections of the site were e-mailed to the participants each week (Table 3).

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Table 3

Intervention: Weekly Activities/E-mails to Participants

Week	Activities
1	E-mail message sent to visit: What is Lifestyle Physical Activity? (Behavioral capabilities) Using a Pedometer (Self-regulation) Monitoring Your Progress (Self-regulation) Choices and Strategies (Self-Efficacy) Calendar of 4 week Intervention E-mail questions related to Research Question 2A to intervention group (Appendix B)
2	E-mail message to give feedback about weekly steps. E-mail message sent to visit: Benefits of Physical Activity (Behavioral capabilities) Safety Issues (Behavioral capabilities) Barrier Identification (Self-regulation) E-mail questions related to Research Question 2C to intervention group (Appendix B)
3	E-mail message to give feedback about weekly steps. E-mail message sent to visit: Links (maps, Utah Walks) Strategies to Deal with Barriers (Self-Efficacy)
4	E-mail message to give feedback about weekly steps. E-mail message to remind participants about data collection Time 2. Submit Intervention Evaluation (intervention group) (Appendix B)

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Procedure

Before undertaking the proposed study, approval was sought from the Institutional Review Boards (IRB) at the University of Utah (U of U) and SUU. At the same time, the Web-CT intervention was developed with specialists in instructional media software at SUU. It was pilot-tested to address any problems before the study began.

Pilot Study

A pilot study was conducted with 25 participants after permission for the study was obtained from the U of U and SUU IRBs. The purposes of the pilot study were to (1) assess the feasibility of using written instruments ("daily activity log," "demographic and personal factors questionnaire," and "competing demands of physical activity questionnaire") and wearing of a pedometer to describe walking behavior in college-aged men and women, (2) identify potential measurement problems, and (3) enhance experience of the researcher with the use of the instruments.

Principally, problems were identified in (1) obtaining a representative sample, (2) collecting data using the pedometer recording sheet, and (3) dealing with missing pedometer data. Analysis of these problems enabled the researcher to strengthen the design of the current study. For example, whereas 80 to 100 potential participants were approached to be in the study, only 25 students volunteered. Most of these students were already physically active. Therefore, better ways to encourage students to participate in this study were considered, such as receiving extra or participation credit in one of their academic courses and gift certificates to their university bookstore. Second, participants

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began recording pedometer data as day 1 to day 7 instead of steps taken on Sunday through Monday.

Students also were asked to estimate how many 10-minute bouts of time they walked. When analyzed, the total steps walked negatively correlated with the time walked in each 10-minute bout. Therefore, the log was either too confusing to complete or directions were not clear. It was decided to change the recording sheets to ensure that students recorded steps according to the day of the week rather than day 1, day 2, etc., and to record only the times the pedometer was put on and taken off, and the total steps taken that day. Another problem occurred because 2 participants forgot to record one of their days of steps taken. Steps taken the day before and the day after the missing data were averaged to replace the missing data. A simpler recording sheet and e-mails to remind participants to record their steps were techniques used for the current study.

Recruitment

Participants in Cedar City, UT, were recruited during spring, summer, and fall semesters from the SUU campus female student population by distributing flyers, displaying posters, e-mail messages, and advertising in the campus newspaper. The researcher also made presentations at summer orientations and other selected classes that included the University Success Course, early education courses, and nursing courses. Examples of the flyer, poster, and recruitment script are contained in Appendix D. I visited classes and the study was explained, students were asked to participate, and interested students were screened for eligibility (Appendix B). Those deemed ineligible for the study were thanked for their interest and given a brief reason explaining why they

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could not participate. In order to protect the rights of the participants in this study, each student was asked to sign an informed consent form (Appendix E). All instruments were then assigned a code to ensure the confidentiality of the participants enrolled in the study. For security, the coded list and all collected data were stored in separated, locked files.

Data Collection

A meeting was arranged during the 1st week of Fall Semester 2005, to complete the consent form. One copy of the consent form was given to the participant and one copy was kept on file. All participants also completed the Demographic Form and Recruitment Questionnaire (Appendix D) at this time.

Data Collection—Time 1

During the first meeting, all students who consented to participate in the study were instructed, through verbal and written means, on how to wear the pedometer, when not to wear the pedometer, the need for keeping the pedometer sealed, and when to meet the researcher for collection of data (Appendix B). Each student walked 50 steps and counted concurrently to calibrate the pedometer for reliability (Vincent & Sidman, 2003). Pedometers that did not record the steps accurately were repositioned to assure that they were 1 to 2 inches on either side of the femur. Those pedometers that still did not measure within 3% of 50 steps (49-51) were replaced with another pedometer until adequate reliability could be attained. After reliability was established, I sealed the pedometer by attaching a sticker over the latch that opens the pedometer. Participants wore the pedometer for 7 consecutive days. Following 7 days of ambulatory activity, I

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collected the pedometers and recorded steps. Participants then completed a self-administered instrument on Exercise Self-Efficacy (Appendix B).

Intervention Period

During the week of Data Collection—Time 1, the researcher randomly assigned participants to the intervention or the control groups by unbiased coin technique. The control group was further randomly assigned to either the sealed-pedometer or the unsealed-pedometer group. All participants were notified of their group assignment in person as they completed the self-administered instrument at the end of Data Collection—Time 1.

The control group was informed of their continuing role in the study as either wearing a sealed pedometer for the next 4 weeks or wearing an unsealed pedometer to record steps taken each day for the next 4 weeks. Participants in the control group wearing the sealed pedometer were given pedometers (reliability was established as previously outlined), the pedometer was sealed by the researcher, and times scheduled during which the researcher met with the participant to record steps taken. Participants in the unsealed-pedometer group were given pedometers (reliability was established as previously outlined) and instructed, both in writing and verbally, on how to wear the pedometers, read the display, and record steps taken using the Recording Sheet (Appendix B). All participants in the control group were asked not to change their physical activity level.

The intervention group participants were scheduled for Web-CT training sessions conducted during the beginning of the following week. Content of the Web-CT training

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sessions has been previously described. At the end of the Web-CT training session, participants in the intervention group were given pedometers (reliability was established as previously outlined) and instructed, both in writing and verbally, on how to wear them. Participants also were instructed on how to read the display and record pedometer steps on an Informal Recording Sheet for Intervention Group (Appendix B).

Participants in the intervention group completed the intervention over the next 4 weeks. They submitted via e-mail, through Web-CT, (1) weekly step goals, (2) weekly steps taken, and (3) responses to questions about context (socio-economic and environmental factors) and maintenance (barriers and strategies to overcome) issues that related to their participation in the study (Appendix B). An evaluation of the intervention was also completed (Appendix B).

Data Collection—Time 2

A second data collection was conducted during the last week of the intervention. Participants in both control and intervention groups were already wearing the pedometer for the last 7 consecutive days of the intervention period. Participants in the sealed-pedometer control group met with the investigator at the end of their 7 days so I could record their steps. Recording sheets from the unsealed-pedometer control group were collected at the end of the 7 days. The intervention group participants submitted their steps on Web-CT. Following 7 days of recorded ambulatory activity, all of the pedometers were collected. All participants completed the self-administered Exercise Self-Efficacy Scale and incentives were then distributed. Table 4 assists to explain the study's timeline. Study protocol is illustrated in Figure 6.

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Table 4

Study Timeline

Activity	Jan 1 - Aug 25	Aug 30-31	Aug 30-31; Sept 9-7	Sept 6-7	Sept 7-8	Sept 9 – Oct 6	Oct 7-11
Develop intervention for Web-CT	X						
Develop training session	X						
Pilot training session	X						
Pilot intervention	X						
Recruit (screening form)	X						
Meet with participants		X					
All participants complete informed consent, demographic form, recruitment questionnaire		X					
Process evaluation: analyze recruitment data		X					
All participants wear sealed pedometer 7 days			X				
Collect pedometer data, administer Self-Efficacy scale				X			
Random assignment to groups: Intervention group (IG), Sealed pedometer control group (SCG), Unsealed pedometer control group (UCG)				X			

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Table 4 Continued

Activity	Jan 1 - Aug 25	Aug 30-31	Aug 30-31; Sept 9-7	Sept 6-7	Sept 7-8	Sept 9 – Oct 6	Oct 7-11
Teach IG Web-CT basics					X		
IG: develop goals, record steps						X	
SCG: meet weekly to collect steps UCG: record steps						X	
IG: Questions r/t context, barriers, and intervention evaluation						X	
Process evaluation: analyze context and maintenance data							X
Collect recording sheets of UCG, steps from SCG, and all pedometers.							X
Administer Self-Efficacy scale							X
Distribute incentives							X
Process evaluation: analyze maintenance data and mediating processes							X

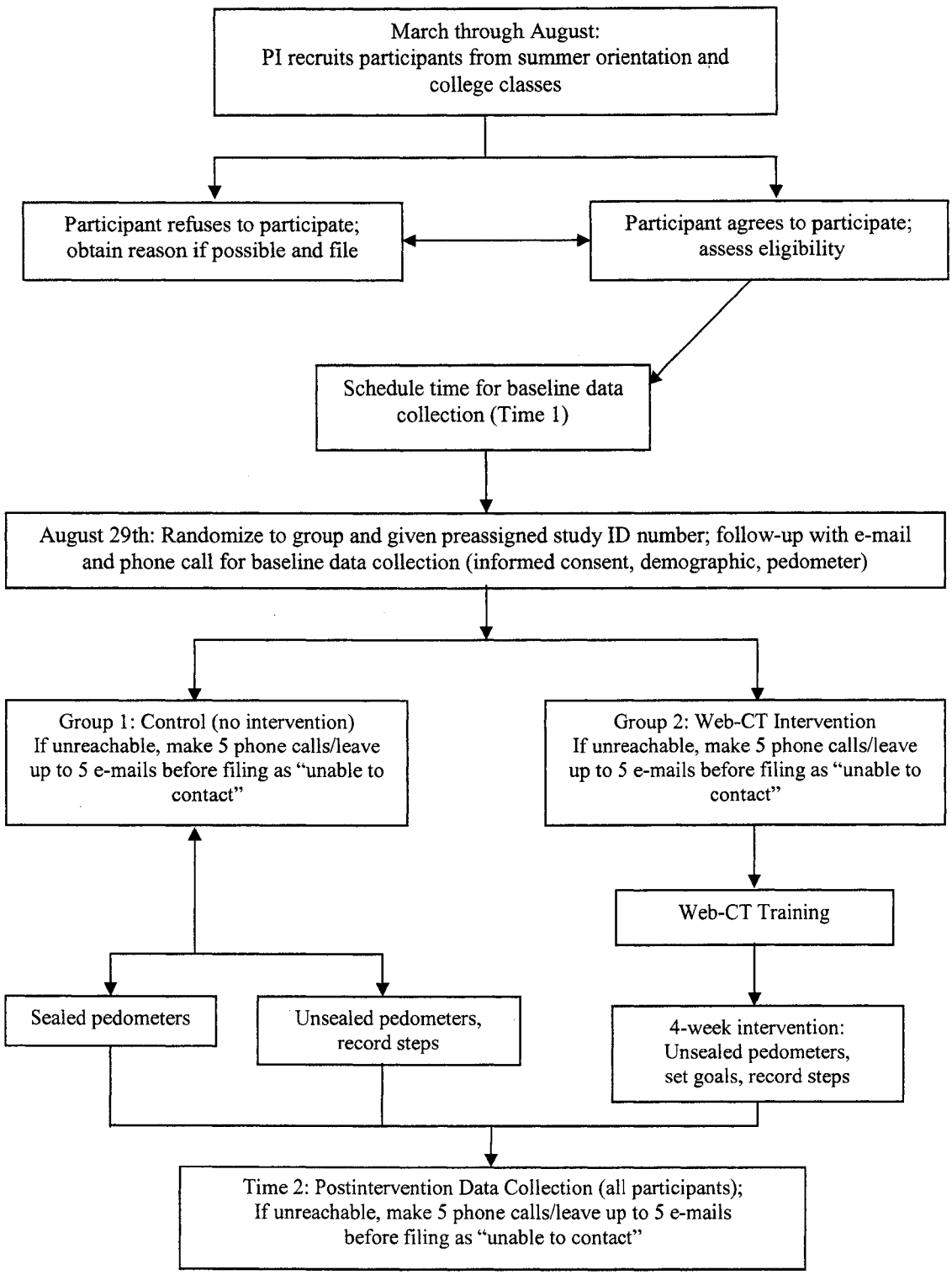

Figure 6. Study protocol.

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Strategies to Deal with Missing Data

Data were reviewed for missing values and managed in the analysis depending on the amount and type of data missing. All data were imputed in some manner, as it is better to formulate missing data than throw away real data (Downey & King, 1998). Missing data were replaced by multiple imputation.

Strategies to Increase Daily Participation and Minimize Missing Data

The following strategies were used to increase participation and completion of the study by participants. First, contracts to finish the study were completed by participants with the understanding that all individuals who completed the study would receive gift certificates. Extra credit in one of their classes was prearranged with professors of academic courses if other extra credit opportunities are also available (Appendix F). Second, $20 gift certificates to the participants' university bookstore were received by participants upon completion of Time 2 data collection. Third, intervention and control group participants who completed Time 2 data collection were entered into a drawing for two $50.00 Wal-Mart Shopping Cards at the end of the study. Additionally, weekly e-mail and phone reminders were sent to participants who failed to submit their weekly goals and recording sheets. Last, the internet intervention was offered to participants in the control group after the completion of Time 2 data collection.

Participants were motivated using several methods. For example, participants were prompted to view a calendar of the intervention that was available on the Website, to visit certain sites within the Web-CT walking intervention, and to submit weekly goal and recording sheets. In addition, e-mails were sent to both Web-CT and personal

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mailboxes to remind and encourage participants. Most important, recognition and intervention with unmotivated participants was a priority to maintain participation in the intervention. Participants who did not submit weekly goals or recording sheets were contacted immediately to determine if a more flexible schedule, technical computer help, or other factors were necessary to facilitate better adherence.

Instruments

Screening Form

The Screening Form (SF) is a questionnaire I developed to gather information about each participant's current level of physical activity and comfort using computers. Six questions about current physical activity level and six questions about comfort level with computers were used to screen eligible participants (Appendix B).

Demographic Form

The Demographic Form (DF) is a questionnaire I developed to gather information about demographic data. Items included age, academic major, academic year, number of credit hours enrolled, housing, marital status, and number of children, if applicable (Appendix D).

Recording Sheet (RS-C) for Unsealed-pedometer Control Group (UCG)

The Recording Sheet (RS-C) is a structured log of self-reports I developed to gather information about physical activity level. Contents included (1) time pedometer was put on; (2) time pedometer was taken off; and (3) number of steps on display at the end of the day for each day (Appendix B).

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Informal Recording Sheet for Intervention Group (RS-I)

The Informal Recording Sheet for Intervention Group (RS-I) is a structured log of self-reports I developed as an informal recording of steps by intervention group participants before they submitted them through Web-CT. Contents included (1) time pedometer was put on, (2) time pedometer was taken off, and (3) number of steps on display at the end of the day for each day (Appendix B). The weekly step goal also was noted as a reminder.

Exercise Self-Efficacy Scale

The Exercise Self-Efficacy Scale was used to measure an individual's perceived confidence to overcome barriers to exercise (Appendix B). Developed by Garcia and King (1991), this instrument was revised by Hallam (1994) using factor analysis and now consists of 15 items. Bandura (1997) stated that self-efficacy is composed of three dimensions: strength, generality, and magnitude. This is a one-dimensional scale that measures the strength dimension of self-efficacy, or how confident one is of overcoming barriers to exercise (Dr. J. Hallam, personal communication, September 13, 2004). Participants were asked to rate from 0% to 100% how confident they are that they would exercise under a variety of situations. Responses to the items are summed and divided by the number of items completed to achieve a mean self-efficacy score. The possible range of scores is 0 – 100. Higher scores mean the participant exhibits a higher level of self-efficacy. Test-retest reliability of the instrument was $r = .96, p < .0001$, and Cronbach's test of internal consistency was $\alpha = .97$ (Hallam & Petosa, 1998). The format of the instrument was revised to make it more readable to participants. Participants were asked

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to rate from 0 to 10 how confident they are that they would exercise under a variety of situations. Responses to the items are summed and divided by the number of items completed to achieve a mean self-efficacy score. The possible range of scores is 0 – 10. Pilot-testing was done to determine if changing the format affected its reliability.

Electronic Pedometer (EP) (Yamax SW-200 Digi-walker)

A motion detector that counts the number of steps taken in a day was used to measure ambulatory activity quantitatively (e.g., number of steps taken). The electronic pedometer (Yamax SW-200 Digi-walker) is a small, 2"x2", device worn on the belt or waistband that measures vertical body displacement with a spring-suspended lever arm that moves up and down with each step (Bassett & Strath, 2002). Reliability for the Yamax SW-200 has been tested extensively. Schneider and colleagues (2004) found there were no significant differences between this pedometer and an average number of steps taken by participants when participants counted the number of steps taken and compared the counted number to the pedometer display. Most important, pedometers are reliable for measuring walking activity with overweight and obese individuals, which is often a characteristic of sedentary females (Swartz, Bassett et al., 2003). The Yamax SW-200 is accurate in determining steps taken at walking speeds of 3 to 5 miles/hour (LeMasurier & Tudor-Locke, 2004). Unfortunately, these pedometers underestimated the steps taken at slower walking speeds; the authors argue that slower speeds (1 to 2 mph) are much slower than what one would do during typical walking. Another study found more error in obese individuals if walking speeds were less than 2 miles per hour (Melanson et al., 2004). Criterion validity has been established between the pedometer and direct

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observation (r = .80 to .97), Tritrac accelerometer (r = .50 to .99), and with heart rate monitors and energy expenditure (r = .62 to .92) (Tudor-Locke, Williams, Reis, & Pluto, 2002).

The Yamax SW-200 Digi-walker pedometer was sealed and worn by both groups for seven consecutive days to record steps/day preintervention. The weekly total number of steps was divided by 7 to obtain the mean steps/day. If the participant did not wear the pedometer each of the 7 days, the number of steps was divided by the number of actual days the pedometer was worn. The pedometers also were used by participants in the intervention group to develop step goals and record daily steps; participants in the unsealed pedometer control group to record steps only (no intervention), and participants in the sealed pedometer control group to determine activity level (no intervention). This was done to differentiate between changes in physical activity level from the exposure to the intervention or the motivating effect of wearing a pedometer.

For this study, context, recruitment, maintenance, and mediating processes were evaluated as to their impact on the implementation, or carrying out, of the intervention. Researcher-developed instruments were used to answer the quantitative portion of the research questions addressing the process evaluation of the intervention.

Weather Data Collection Form

The weather, though uncontrollable, was monitored daily throughout the intervention for temperature, humidity, wind, and precipitation (Appendix B).

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Recruitment Quantitative Data Collection Form

The Recruitment Quantitative Data Collection Form was used to obtain recruitment information about the intervention study (Appendix D). These data are routinely collected and analyzed as part of all research studies and consists of two main sections: (1) information about the sample and (2) methods used to recruit the sample. The information concerning the sample included (1) recruitment information on total number of females in classes approached, (2) number of females eligible for the study, and (3) number of females who consented to participate in the study. Percentages of those recruited from the number of potential participants and attrition rates were calculated. Methods used to recruit the sample were categorized as to flyers, posters, newspaper ads, classes visited, and student orientations visited. A list of incentives also was compiled. This information was used to determine the amount of time and effort needed to recruit and the most effective recruiting methods.

Recruitment Questionnaire

A Recruitment Questionnaire was used to obtain information from the participant concerning the methods used to recruit them into the study (Appendix D). All of the participants were asked using open-ended questions asking why they were participating in the study and if any method was more effective than others in convincing them to participate in the study.

Maintenance Quantitative Data Collection Form

The Maintenance Quantitative Data Collection Form was used to determine if maintenance issues, or those methods used to keep participants involved in the

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intervention and data collection aspects of the study, affected the intervention (Appendix B). This form was composed of two sections: (1) attendance at data collection/training sessions and submission of weekly goals and recording sheets, and (2) the number and times the Web-CT intervention Website was visited each week during the intervention.

Data Analysis

The hypotheses, research questions, and the type of data directed the data analysis of this study. Data were analyzed using SPSS Statistical Package for the Social Science©, version 12.0 for Windows. A level of $\alpha = .05$ was employed to determine statistical significance for all analyses of this research. The following is a description of the data analysis was used for each hypothesis and research question.

Hypothesis 1

College-aged women using a pedometer and receiving a Web-based physical activity intervention (SUU Women on the Move Walking Program) will have significantly greater mean pedometer steps than college-aged women not receiving the intervention.

Rationale

College-aged women are at risk for developing lifestyles of inactivity. Physical inactivity is a risk factor for cardiovascular disease, diabetes, osteoporosis, and some cancers. Therefore, college-aged women are a high-risk group that health care professionals should target for health promotion to prevent the adoption of sedentary lifestyles in the years from college to career.

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Data Expected, Analysis, and Interpretation

To assess the efficacy of an intervention on physical activity levels, pedometers were used to compare walking (steps/day) between college-aged women in an intervention group and a control group. Expected data consisted of mean steps/day as measured by pedometer collected at 5 different times to attain physical activity level. Data were collected at baseline from the sealed pedometers of all participants. Data were collected weekly from the sealed-pedometer control group and from the recording sheets that participants in the intervention submitted through Web-CT. Data were from the recording sheets of the unsealed-pedometer control group at the end of the intervention period.

Data were checked for normality and skewness and, if necessary, transformed using methods outlined by Munro (2001). Statistical treatment of data was by repeated measures analysis of variance (RM-ANOVA). This multivariate test assesses performance trends over time and reduces error from individual differences (Stevens, 2002). First, it was determined if there was a difference in the mean pedometer steps in the sealed pedometer control group and unsealed pedometer control group. If the steps were similar, data were collapsed into one control group and a RM-ANOVA between the intervention group and combined control groups was performed to determine if there was a time-by-group interaction effect (Table 5). If the steps were different, a RM-ANOVA between all three groups was performed to determine if there was a time by group interaction effect (Table 6). If overall F was significant, post-hoc tests were used to find where differences were between the scores. Significant results indicated the intervention increased physical activity.

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Table 5

Collapsed Control Group

Group	Time 1	Time 2	Time 3	Time 4	Time 5
I ($n = 71$)	*M*	*M*	*M*	*M*	*M*
C ($n = 71$)	*M*	*M*	*M*	*M*	*M*

Table 6

Control Groups Separated

Group	Time 1	Time 2	Time 3	Time 4
I ($n = 71$)	*M*	*M*	*M*	*M*
C-sealed ($n = 35$)	*M*	*M*	*M*	*M*
C-unsealed ($n = 35$)	*M*	*M*	*M*	*M*

Hypothesis 2A

Increased self-efficacy will mediate the relationship between the intervention and physical activity in college-aged women who are exposed to a Web-based physical activity intervention (SUU Women on the Move Walking Program).

Rationale

Community intervention studies have failed to produce consistent results, thus process evaluations should be done to determine reasons why and how interventions are or are not successful. Several types of process evaluations are outlined in the literature. This intervention evaluated mediating mechanisms, context, recruitment, and

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maintenance as components of a process evaluation. Several researchers argue that mechanisms of behavior change need to be understood before effective interventions can be developed and expanded. Therefore, it is important to evaluate the mediating variables within the intervention that increases success of outcome with the participants.

Data Expected, Analysis, and Interpretation

To assess mediating mechanisms between the intervention and behavioral outcome, one theoretical (mediating) variable was measured, self-efficacy. Expected data consisted of mean difference scores from Time 5 minus Time 1 as measured by pedometer (steps/day) and mean difference scores as measured by the Exercise Self-Efficacy Scale.

The statistical treatment of data used for mediation analysis involves correlation, multiple regression, and significance testing. The data were checked for meeting the assumptions of multiple regression analysis, including normality, multicolinearity, and homoscedasticity. Expanding on the model developed by Baron and Kenny (1986), the Sobel Test provides a more precise test of the mediation path (Dudley, Benuzillo, & Carrico, 2004). According to Dudley and colleagues, although the multiple regression analysis method utilized by Baron and Kenny does not require special software or large samples, it does not give information as to the strength of mediation as does the Sobel Test.

The procedure used to test for significance of the mediation model consisted of (1) computing raw correlations among the three variables (group, self-efficacy, and pedometer steps), (2) performing a multiple regression where the independent variable

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(group) predicts the dependent variable mediator (self-efficacy), and (3) performing a multiple regression analysis where the independent variables (group and self-efficacy) predict the dependent variable (pedometer steps). Finally, a *t*-test (the Sobel Test) was computed. MacKinnon and Dwyer (1993) outline the "Sobel Test" as:

$$t_{a*b} = \frac{a*b}{se_{ab}}$$

where: $se_{ab} = \sqrt{(a^2 * se_b^2) + (b^2 * se_a^2)}$

Within these formulas, *a* is the unstandardized regression coefficient for the association between the IV and mediator (step 2), *b* is the unstandardized regression coefficient for the association between the mediator and the dependent variable (when the independent variable is also a predictor of the dependent variable) (Step 3), and se_a and se_b refer to the standard errors of these coefficients.

Research Question 2A

According to participants, what social, economic, or environmental factors contributed to participation in the SUU Women on the Move walking program?

Rationale

Context refers to the setting surrounding the intervention that leads to its success or failure in achieving the outcome. Examples of context include physical, social, or economic factors. Context components of process evaluation were assessed through the triangulation of quantitative (weather data collection form) and qualitative (e-mailed open-ended questions) measures.

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Data Expected, Analysis, and Interpretation

A form was developed to collect *quantitative data* on which participants recorded the weather conditions for each day of the intervention (Appendix B). Descriptive statistics were used to describe the findings.

The intervention group was sent an e-mail consisting of questions to collect *qualitative data* about social, economic, and environmental factors that may encourage or discourage their walking (Appendix B). The questions are:

1. Women often have specific social, economic, or environmental factors that affect their walking. What factors affect your walking?
2. Tell me how you are meeting your walking goal.
3. What encourages you to walk?
4. What discourages you from walking?

Participants' responses were submitted via e-mail on Web-CT. The qualitative treatment of data consisted of data reduction, data display, and conclusions/verification. Participants' responses were reduced into codes; the codes are labels that are attached to words, phrases, or sentences that organize the data into meaningful categories (Miles & Huberman, 1994). Codes allowed the data to be retrieved, organized, and clustered into patterns or themes. Matrices were constructed to display the data outlining the patterns or themes with supporting codes or quotes. Finally, conclusions were made using counting, clustering and noting patterns, and making theoretical coherence using guidelines by Miles and Huberman (1994). Verification was accomplished by using a colleague to

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review matrices and conclusions. Results were analyzed simultaneously with data collection. Data were reported textually, displayed in matrices, and in narrative form.

Research Question 2B

According to the participants, what factors contribute to successfully recruiting them to participate in the SUU Women on the Move walking program?

Rationale

Recruitment is an important issue when determining how and why participants enter into intervention programs. Methods used to recruit sedentary women into physical activity interventions require identification and dissemination. Recruitment components of process evaluation were assessed through the triangulation of quantitative (recruitment quantitative data collection form, recruitment questionnaire) and qualitative (open-ended questions on recruitment questionnaire) measures.

Data Expected, Analysis, and Interpretation.

Quantitative data were collected concerning recruitment and maintenance of research participants as follows:

1. Number of females in the classes or orientation groups approached by the PI was totaled.
2. Number of females who were eligible to participate in the study was totaled.
3. Number of females who consented to participate in the study was totaled.
4. Numbers of potential participants were compared to numbers of actual participants.

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5. Attrition rate was calculated at end of study
6. Forms of recruitment were catalogued as to number and location distributed, such as flyers, posters, newspaper ads, classes approached with recruitment script (Appendix D).

Descriptive statistics were used to describe the findings.

Open-ended questions to collect *qualitative data* were asked of all of the participants in the study about recruitment methods used for this study. The questions were:

1. Tell me what the reasons you signed up for this program are.
2. What do you think are the most effective methods of recruitment (poster, visits by program director, brochure) used for this program?
3. What suggestions for incentives do you have that would be better or more useful to participants in this program?

The qualitative treatment of data consisted of data reduction, data display, and conclusions/verification. As noted previously, participants' responses were reduced into codes. The codes allowed the data to be retrieved, organized, and clustered into patterns or themes. Matrices were then constructed to display the data outlining the patterns or themes with supporting codes or quotes. Finally, conclusions were made using counting, clustering and noting patterns, and making theoretical coherence using guidelines by Miles and Huberman (1994). Verification was accomplished by using a colleague to review matrices and conclusions. Results were analyzed simultaneously with data collection. Data were reported textually, displayed in matrices, and in narrative form.

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Research Question 2C

According to the participants, what program factors contribute to keeping them actively involved in the SUU Women on the Move walking program?

Rationale

Maintenance refers to which methods used in the intervention were successful in keeping participants actively involved in the intervention and/or the data collection procedures; for example, incentives, reminders, and frequent feedback. Maintenance components of process evaluation were assessed through the triangulation of quantitative (maintenance quantitative data collection form) and qualitative (open-ended questions on intervention evaluation form) measures.

Data Expected, Analysis, and Interpretation.

The following *quantitative data* were collected: (1) attendance at pretest data collection, (2) attendance at posttest data collection (3) attendance of intervention group at Web-CT training sessions, (4) logging-in information of intervention group participants to Web-CT, (5) submission of goals and weekly steps taken by intervention group participants, and (6) submission of recording sheets by unsealed-pedometer-control group participants (Appendix B). Descriptive statistics were used to describe the data.

Questions were asked of intervention group participants to obtain *qualitative data* concerning their engagement and retention in the program. The questions were:

1. What encourages you to walk?
2. What discourages you from walking?

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3. You have been involved in the SUU Women on the Move Walking Program. What about the program has motivated you to stay involved? What has discouraged your involvement?

Additionally, all intervention participants were given short survey questions after each module about how useful the information was within the module and if they had suggestions for improving its delivery. Last, the total intervention was evaluated with questions relating to:

1. Tell me how you feel about using the computer for this program.
2. What do you think are the strengths of this program?
3. What suggestions do you have for improving this walking program?
4. How would you describe your overall feeling about the walking program? (Appendix B).

Participants' answers to the e-mailed questions about engagement and retention and their evaluations were submitted via e-mail using Web-CT. The qualitative treatment of data consisted of data reduction, data display, and conclusions/verification. As noted before, participants' responses were reduced into codes. The codes allowed the data to be retrieved, organized, and clustered into patterns or themes. Matrices were then constructed to display the data outlining the patterns or themes with supporting codes or quotes. Finally, conclusions were made using counting, clustering and noting patterns, and making theoretical coherence using guidelines by Miles and Huberman (1994). Verification was accomplished by using a colleague to review matrices and conclusions. Results were analyzed simultaneously with data collection. Data were reported textually, displayed in matrices, and in narrative form.

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Limitations of Study

The following limitations of this study have been identified. First, this was a volunteer sample of mostly White, college-aged women from a university in Cedar City, UT, and, therefore, some self-selection bias was present. Volunteer samples can reduce the ability to generalize results to other populations. Second, as with any study, there is some amount of attrition expected, whether it is from voluntary drop out, illness, injury, or lack of interest in completing the study. The data analysis plan considered attrition and increased the proposed sample size. Every effort also was made to verify email addresses and phone numbers of the participants.

A third limitation was that the pedometer used in this study measured only frequency, not duration or intensity, of lifestyle physical activity behavior. As reviewed previously, interventions that increased the frequency of walking have shown positive health benefits.

All attempts to minimize missing data with e-mail reminders, phone calls, and forms to record steps during the intervention were implemented. I also checked for missing data and computed necessary imputations before final data analysis.

Last, study participants were randomly assigned to one of two groups. However, all study participants were students from one university campus and may have talked among themselves about the study. Contamination may have lead to minimized differences in physical activity behavior between the groups.

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Summary

An experimental, repeated-measures design was used to determine the efficacy of a physical activity intervention with college-aged women. The intervention group used the internet to receive theory-based interactive activities, based on Social Cognitive Theory of behavior change. The control group was asked not to change their activity. Data were collected at 5 times for steps per day (steps/d, Yamax SW 200 pedometer) and pre- and postintervention for scores on the Exercise Self-Efficacy scale. To examine whether walking behavior increased as a result of the intervention, RM ANOVA was used to assess changes in steps/d over time. To examine whether self-efficacy was a mediating variable for the changes in walking behavior, a mediation model (Baron & Kenny, 1989) was tested and the significance of the model was determined using Sobel's test (MacKinnon & Dwyer, 1993). A process evaluation gave critical information as to context, recruitment, maintenance, and mediating mechanisms of behavior change.

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CHAPTER IV

RESULTS

The results of data analysis for each research hypothesis and research question are presented in this chapter. The characteristics of the sample and the reliability of the Exercise Self-Efficacy Scale for the study also are described. This chapter also describes the results of the pilot tests for the revised format of the Exercise Self-Efficacy Scale and the intervention.

Pilot-test of the Exercise Self-Efficacy Scale

The Exercise Self-Efficacy Scale, in its original and revised forms, was pilot tested. Data for this pilot study were acquired from college students from the campus of Southern Utah University (SUU). Participants qualified for the study if they were female and at least 18 years of age. A group of female students ($n = 32$, $M = 22.22 \pm 5.39$ years) enrolled in communication and nutrition science classes completed the instrument twice in a 1 week interval. Two students did not complete the scales at Time 2 because of extended absence due to illness. Ages, college of academic major and academic year of the sample are described in Table 7.

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Table 7

Demographic Characteristics of Participants for Pilot Study (n = 32)

Characteristic	n	%
Age		
18 – 20	15	47
21 – 23	12	38
24 – 26	2	6
27 – 29	1	3
>30	2	6
College of Academic Major		
Humanities	22	69
Science	7	22
Business	1	3
Visual/Performing Arts	1	3
Undeclared	1	3
Academic Year		
Freshman	2	6
Sophomore	4	13
Junior	7	22
Senior	19	59

Questions developed for the pilot study were:

1. What are the test-retest and internal consistency reliabilities of the original Exercise Self-Efficacy Scale?
2. What are the test-retest and internal consistency reliabilities of the revised Exercise Self-Efficacy Scale?
3. Were the test-retest and internal consistency reliabilities of the original and revised versions of the Exercise Self-Efficacy Scale different?
4. Were the test-retest and internal consistency reliabilities of both scales acceptable as recommended by the scientific community?

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Procedure

Prior to the initiation of the study, IRB approval was obtained, Verbal information about the study was given and consent was assumed if the instruments were completed. Data were identified by a predetermined ID number (from 1 to 32) that only the participant knew. Therefore, testing procedures were anonymous. Brief demographics were collected to describe the sample (age, college of academic major, and academic year).

Instruments

The Exercise Self-Efficacy Scale (original format)

The Exercise Self-Efficacy Scale is used to measure one's perceived confidence in being able to overcome barriers to exercise and consists of 15 items (Hallam, 1994). This scale, originally developed by Garcia and King (1991), was reduced to 15 items by Hallam after factor analysis identified items that reflected the strength dimension (confidence to overcome barriers). Examples of questions on the scale are "How confident are you that you could exercise when tired?" and "How confident are you that you could exercise when on vacation?" Respondents read each item and rated their belief that they could overcome the proposed barrier on a scale of 0% to 100%. Responses to the items were summed and divided by 15 to achieve a mean self-efficacy score. The possible range of scores was 0 to 100. Using a sample of 86 adults from a service-related worksite, test-retest reliability of the instrument was $r = .96, p < .0001$, and Cronbach's test of internal consistency was $\alpha = .97$ (Hallam & Petosa, 1998).

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The Exercise Self-Efficacy Scale (revised format)

The format of the original instrument was revised to make it more readable and "user-friendly" for participants. Using the same wording, the word "exercise" was added to the stem and removed from each item. Anchors from the original version were used with small boxes associated with numerical values replacing the blank lines for each item. Respondents read each item and rated their belief that they could overcome the proposed barrier on a scale of 0 to 10. According to DeVellis (2003), numerical response items allow respondents to assess quantity more effectively than nonvisual methods. Percentages were not used to reduce clutter and to make it easier for respondents to complete. Respondents were asked to read each item and rate their belief that they could overcome the proposed barrier on a scale of 0 to 10. Like the original scale, responses to the items were summed and divided by 15 to achieve a mean self-efficacy score. The possible range of scores was 0 to 10. Higher scores meant greater self-efficacy for exercise.

After the study was explained and informed consent obtained, participants completed both the original and revised versions of the Exercise Self-Efficacy Scale. The order in which participants were asked to complete the scale was varied to reduce the possibility that test order might confound the results. After 1 week, I returned to the classrooms to repeat the process. This 1-week interval was chosen because Streiner and Norman (2003) state that 2 to 14 days is the usual retest interval and no intervention was given that could change the scores on the constructs.

Scores on the scales were summed and a mean obtained for each scale and each time. Data were analyzed using SPSS for Windows© (version 12). The data were

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assessed for missing data. In two situations, students were unable to participate during Time 2 data collection; therefore, their data were deleted from the analysis.

Statistical Analysis

The one-way, random-effects ANOVA method of calculating an intraclass correlation coefficient (ICC) was used to determine test-retest reliability of the Exercise Self-Efficacy Scale. First, the data were analyzed to determine if they met the assumptions of normality. Normality was assessed by looking at the means and standard deviations, histograms, and the Fisher Skewness Coefficient. The intraclass correlation coefficient (ranging from 0 to 1) is an index of concordance for continuous data. An intraclass correlation coefficient of less than 0.4 is considered poor, 0.4 to 0.75 is considered fair, and greater than 0.75 is considered excellent (Rosner, 2000).

Next, Cronbach's alpha of internal consistency was obtained for both versions of the scale to determine internal consistency among the items. A Cronbach's alpha of internal consistency between 0.80 and 0.94 is considered acceptable and one greater than 0.95 is considered excellent (Nunnally & Bernstein, 1994). The original and revised scales also were examined to determine if there was significant difference in the statistical scores between the two scales and that scale items reliability differed from that previously reported in the literature.

Results

The exercise self-efficacy construct for the original and revised versions of the Exercise Self-Efficacy Scale was measured twice. Evaluation of the skewness and kurtosis coefficients (Pett, 1997) indicated that the total scale scores were normally

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distributed. The Fisher Skewness Coefficient for the original and revised test scores (Time 1) equaled −1.71 (−.706/.414) and −1.29 (−.534/.414), respectively; and the retest scores (Time 2) equaled −1.78 (−.762/.427) and −1.63 (−.694/.427), respectively. These coefficients were all between +1.96 and −1.96, indicating that the distributions were not significantly different from a normal distribution. The means, standard deviations, Cronbach's alpha for internal consistency, ICC, and paired *t*-tests are shown in Table 8 for each version of the instrument for Time 1 and Time 2.

This pilot study examined the reliability of the Exercise Self-Efficacy Scale to determine if reliability coefficients were different if the instrument was revised in format and if reliability changed in a college-aged female population. According to Rosner (2000), intraclass correlation coefficients greater than 0.75 are considered excellent. Therefore, results from this study suggest that the Exercise Self-Efficacy Scale has excellent reliability for use in research. Results also indicated that test-retest reliability and internal consistency did not change for the revised scale in this sample of college-aged women. Values for both the intraclass correlation and internal consistency tests were almost identical between the two forms of the scale.

Pilot-test of the Intervention

The SUU Women on the Move walking program was constructed using the WebCT online teaching software program. Components of the walking program included a calendar, information modules, links, forms/evaluation form, and an electronic bulletin board. The walking program presented nine information modules on lifestyle physical activity, safety issues and tips, benefits of physical activity, choices and strategies,

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Table 8

Means, Standard Deviations, Cronbach's Alpha for Internal Consistency, ICC, and Paired *t*-tests for Original and Revised Exercise Self-Efficacy Scale ($n = 30$)

	Test		Retest		Cronbach's alpha coefficient				
Version	*M*	*SD*	*M*	*SD*	Test	Retest	ICC	*t*(29)	*p*
Original	71.2	21.2	70.0	24.2	0.96	0.98	0.96	.39	.70
Revised	6.9	2.1	6.9	2.4	0.95	0.98	0.96	−.99	.33

identifying barriers, overcoming barriers, monitoring progress, how to use a pedometer, and where to walk in Cedar City, UT. The program included links to Websites on stretching, barrier identification and reduction, and walking information. Microsoft PowerPoint™ and Macromedia Breeze™ software programs were used to develop the information modules. Six women from SUU were asked to pilot-test the intervention for ease of use, ease of understanding of content, and discovery of any problems with logging on, viewing content, or submitting forms. Four were staff members, one was a faculty member, and one was a pre-med student in her senior year. Problems related to the modules included a slow, casual audio track on a few of the modules, that some of the testers reported made them frustrated, and evidence of mistiming in the animation on one of the content modules. There also were difficulties in viewing the modules on computers in places that used a dial-up internet service. To address these problems, the audio tracks were re-recorded to increase the speed of speech and the animations were retimed to

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match the audio track. All nine modules were copied onto 10 compact discs (CD). The CDs enabled participants who might want to view the program from a home computer connected to the internet via a dial-up service to borrow a CD from me to view the modules without difficulty.

Thus, the intervention was developed and tested to identify problems with content or delivery prior to beginning the study. Once problems were corrected, the data collection period proceeded.

Findings of the Research

The findings for each specific purpose, research hypothesis and research question are presented. Additionally, a description of the sample and reliability of the Exercise Self-Efficacy Scale for this study are reported.

Description of the Sample

Two hundred and ten (210) students met the eligibility criteria for the sample. A power analysis conducted prior to the study indicated that a sample size of 75 was needed to test for group effect of the intervention, and an estimated sample size of 128 was needed to test for mediation; therefore, the goal for recruitment was 128 participants. One hundred and twenty-one (121) students consented and 112 students completed the study. The reasons for women not completing the study included forgetting to put the pedometer on (n = 3) and the feeling that the intervention was "too much work" (n = 2). One student dropped out because of a family emergency that caused her to miss school, 3 students were lost to follow-up. When demographic and baseline data from the dropouts were compared to data from those who finished the study, dropouts were not significantly

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different from participants in terms of age, ethnicity, marital status, academic major, academic year, income, housing arrangements, employment status, and transportation to school. Dropouts were significantly different in physical activity level at baseline, and had greater mean steps/day at baseline (9756) than participants who finished the study (7674). Data collection began on August 30, 2005, and ended on October 7, 2005, in Cedar City, UT.

The Demographic Questionnaire was used to obtain information on age, academic college of major, academic year, number of credit hours enrolled, housing, marital status, and number of children, if applicable. The sample consisted of 121 females who ranged in age from 18 and 34 years (mean = 20.6 ± 3.2) and in body mass index (kg/m^2) from 16 to 54 (mean = 25.2 ± 6.2). Steps for the baseline period of 7 days ranged from 4061 to 95,041 (mean = 7780 ± 2362). These steps indicate that the sample ranged in baseline behavior from sedentary to very active with an average of being somewhat active. Self-efficacy mean scores at baseline ranged from 1.53 to 8.87 (mean = 5.7 ± 1.5). These scores indicate that this sample ranged in their confidence to overcome barriers from no confidence to very confident with an average of being moderately confident. Means and standard deviations of participants are presented in Table 9.

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Table 9

Means and Standard Deviations of Participant Characteristics

	Group Assignment					
	Intervention ($n = 60$)		Control ($n = 61$)		Total ($n = 121$)	
Characteristic	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	20.7	2.8	20.6	3.5	20.6	3.2
Height (inches)	65.4	3.4	65.7	2.7	65.5	3.1
Weight (kg)	69.0	14.1	70.2	18.4	69.6	16.4
BMI (kg/m^2)	25.3	6.3	25.2	6.1	25.2	6.2
Credit hours enrolled	15.0	2.5	14.9	3.1	14.8	2.8
Self-Efficacy mean score	5.8	1.6	5.6	1.5	5.7	1.5
Baseline steps/day	7923	1885	7637	2768	7780	2362

The majority of participants were White (95%), freshman (54.5%), and not married or in a committed relationship (76.0%). Of the 29 women who were married/partnered or divorced, 13 had between one and three children. Participant characteristics are summarized in Table 10. Chi-square tests of independence were undertaken between the demographic variables (ethnicity, academic major, academic year, housing, transportation, household income, marital status, and thoughts about physical activity) and assignment to group. Independent *t*-tests were run to determine whether there were differences between the intervention and control groups with regard to age, height, weight, body mass index (BMI), and number of credit hours. The tests were

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Table 10

Demographic Characteristics of Participants

Characteristic	Membership Group: Intervention (n = 60) n	%	Control (n = 61) n	%	Total (n = 121) n	%
Age						
18 – 21	40	33.1	47	38.8	87	72.0
22 – 25	16	13.2	9	7.4	25	20.7
26 – 29	4	3.3	2	1.7	6	5.0
30 – 34	0	-	3	2.5	3	2.5
Body Mass Index (kg/m^2)						
Underweight: <18	5	4.1	3	2.5	8	6.6
Normal weight: 18.5-24.9	29	23.4	32	26.4	61	50.4
Overweight: 25-29.9	16	13.2	17	14.0	33	27.3
Obese: ≥30	10	8.3	9	7.4	19	15.7
Ethnicity						
Caucasian	56	46.3	59	48.8	115	95.0
Pacific-Islander	2	1.7	1	0.8	3	2.5
Hispanic	1	0.8	-	-	1	0.8
Other: Asian	1	0.8	1	0.8	2	1.7
Academic College for Major						
Science	17	14.0	17	14.0	34	28.1
Education	13	10.7	12	9.9	25	20.6
Humanities	14	11.6	18	14.8	32	26.4
Visual/performing arts	6	5.0	3	2.4	9	7.4
Business	4	3.3	4	3.3	8	6.6
Undecided	6	5.0	7	5.8	13	10.7
Academic Year						
Freshman	34	28.1	32	26.4	66	54.5
Sophomore	6	5.0	13	10.7	19	15.7
Junior	8	6.6	12	9.9	20	16.5
Senior	12	9.9	4	3.3	16	13.2

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Table 10 continued.

Characteristic	Membership Group: Intervention (n = 60) n	%	Control (n = 61) n	%	Total (n = 121) n	%
Housing						
With parents	7	5.8	4	3.3	11	9.1
Home/apartment (alone)	3	2.5	1	0.8	4	3.3
Home/apartment (with others)	34	28.1	36	29.8	70	57.9
Dormitory	16	13.2	20	16.5	36	29.8
Transportation						
Walk	34	28.1	35	28.9	69	57.0
Bike	-	-	3	2.5	3	2.5
Car	26	21.5	23	19.0	49	40.5
Bus	-	-	-	-	-	-
Household Income						
Less than $20,000	37	30.6	27	22.3	64	52.9
$20,000 to $39,999	8	6.6	11	9.0	19	15.7
$,000 to $69,999	6	5.0	11	9.0	17	14.0
Greater than $70,000	2	1.7	6	5.0	8	6.6
Declined to answer					13	10.7
Work						
Not working	26	21.5	37	30.6	63	52.1
Working part-time	25	20.7	21	17.4	46	38.0
Working full-time	8	6.6	3	2.5	11	9.1
Perception of Physical Activity						
Male activity	-	-	-	-	-	
Waste of time	1	0.8	1	-	1	-
Good for health	57	47.1	53	43.8	110	.8
Other	2	1.7	8	6.6	10	90.9

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conducted to determine if there were any differences in the groups before the intervention; there were no significant differences in demographic characteristics between the control group and intervention group. After random assignment to an intervention or control group, participants in the control group were further divided into a sealed pedometer or unsealed pedometer group. This partition was done to differentiate between changes in physical activity level from exposure to the intervention or the motivating effect of wearing a pedometer. There were no significant differences in baseline steps/day between the intervention and control group or between the sealed and unsealed control groups.

Reliability of the Exercise Self-Efficacy Scale

A paired-samples *t*-test was conducted to evaluate if there were statistically different scores for the Exercise Self-Efficacy Scale for Time 1 and Time 2, $t(112) = 1.72$, $p = .08$. These results indicated that the mean scores for exercise self-efficacy were not significantly different between Time 1 and Time 2. The means, standard deviations, Cronbach's alpha for internal consistency, and paired *t*-test are shown in Table 11 for the Exercise Self-Efficacy Scale for Time 1 and Time 2.

Purpose 1

Purpose 1 was to use Social Cognitive Theory to design and implement a theory-based 4-week physical activity intervention to promote and increase lifestyle physical activity in college-aged women administered by Web-based media (Web-CT).

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Table 11

Means, Standard Deviations, and Cronbach's Alpha for Internal Consistency for Exercise Self-Efficacy Scale

Time	*M*	*SD*	Cronbach's alpha coefficient
1 ($n = 119$)	5.7	1.5	0.90
2 ($n = 113$)	5.8	1.6	0.92

Hypothesis 1

College-aged women using a pedometer and receiving a Web-based physical activity intervention (SUU Women on the Move Walking Program) will have significantly greater mean pedometer steps than college-aged women not receiving the intervention.

Group Difference in Mean Pedometer Steps

There were 26 cases (3%) of missing pedometer steps within the intervention and unsealed pedometer control groups. As data were recorded on a recording sheet similar to a calendar, I observed that the steps on individual recording sheets were within 500 steps depending on the day of the week. Therefore, missing data for the pedometer steps were replaced by taking a mean of the steps taken by the individual on the same day of the week as the missing datum. Data were checked for normality and skewness. The mean steps were normally distributed overall, at all time periods, and within each group. Exceptions to a normal distribution were overall at Time 4, within the intervention group

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at Time 5, and within the control group at Times 4 and 5. Table 12 presents the skewness coefficients and tests for normality for the distributions.

The data were checked for meeting the assumptions of repeated measures analysis of variance, including multicollinearity, linearity, and outliers. Concerning multicollinearity, four variables were highly correlated at >0.80. These were the mean steps at Times 2 and 3, Times 3 and 4, Times 3 and 5, and Times 4 and 5. Box plots identified one outlier at Time 1 and three outliers at Times 4 and 5. Four of the outliers were in the intervention group. These 4 participants showed an increase in steps which would be expected as they were members of the intervention group. Three of the outliers

Table 12

Skewness Coefficients and Tests of Normality for Mean Pedometer Steps

	Overall	Intervention Group			Control Group		
Time	Skewness coefficient	Skewness coefficient	K/S	S/W	Skewness coefficient	K/S	S/W
1	-.74	-.05	.20 NS	.95 NS	-.44	.20 NS	.91 NS
2	.60	1.06	.20 NS	.22 NS	.86	.10 NS	.09 NS
3	1.23	1.57	.20 NS	.17 NS	1.19	.20 NS	.56 NS
4	2.33 [a]	1.81	.20 NS	.15 NS	2.61[a]	.01	.01
5	1.84	2.15 [a]	.20 NS	.07 NS	2.15[a]	.01	.01

[a] Distributions were significantly different from a normal distribution.

K/S = Kolmogorov-Smirov; *S/W* = Shapiro-Wilks; *NS* = not significantly different from a normal distribution

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were in the control group. One of these participants had an increase in steps over the weekend at Time 4. One explanation for this increase is that the participant was involved in shopping or hiking activities. Another participant in the control group had an increase in steps over the entire week (Time 5) indicating that something was occurring at the school or workplace that caused an increase in activity. Only the outlier at Time 1 (control group) showed a decrease in steps.

A repeated measures analysis of variance was conducted to determine if there was a difference in the mean pedometer steps in the sealed pedometer control group and unsealed pedometer control group. There was a significant difference in the mean steps between the two groups, $F(1, 57) = 4.0$, $p = .050$. Post hoc t-tests were used to determine which times where significantly different. The Bonferroni procedure was used to correct for the possibility of Type 1 error; therefore, the significance level for the t-test was .01. Post hoc tests were significant for time 5 [$t(57) = 2.56, p = .01$]. The sealed pedometer group had a mean of 6678 ± 2815 at Time 5, whereas the unsealed pedometer control group had a mean of 8886 ± 3724. That is, participants with unsealed pedometers took significantly more steps than participants with sealed pedometers during the last week of the study. One explanation for this finding is that the pedometer may have influenced the steps taken in the unsealed pedometer group resulting in an increase in their steps, whereas those participants in the sealed pedometer group took fewer steps during the week. Figure 7 illustrates the mean pedometer steps plotted over time for the sealed and unsealed pedometer control groups.

Since the only statistically significant difference in steps between these two groups was during week 5, and to meet the assumption of equal cell sizes, the data were

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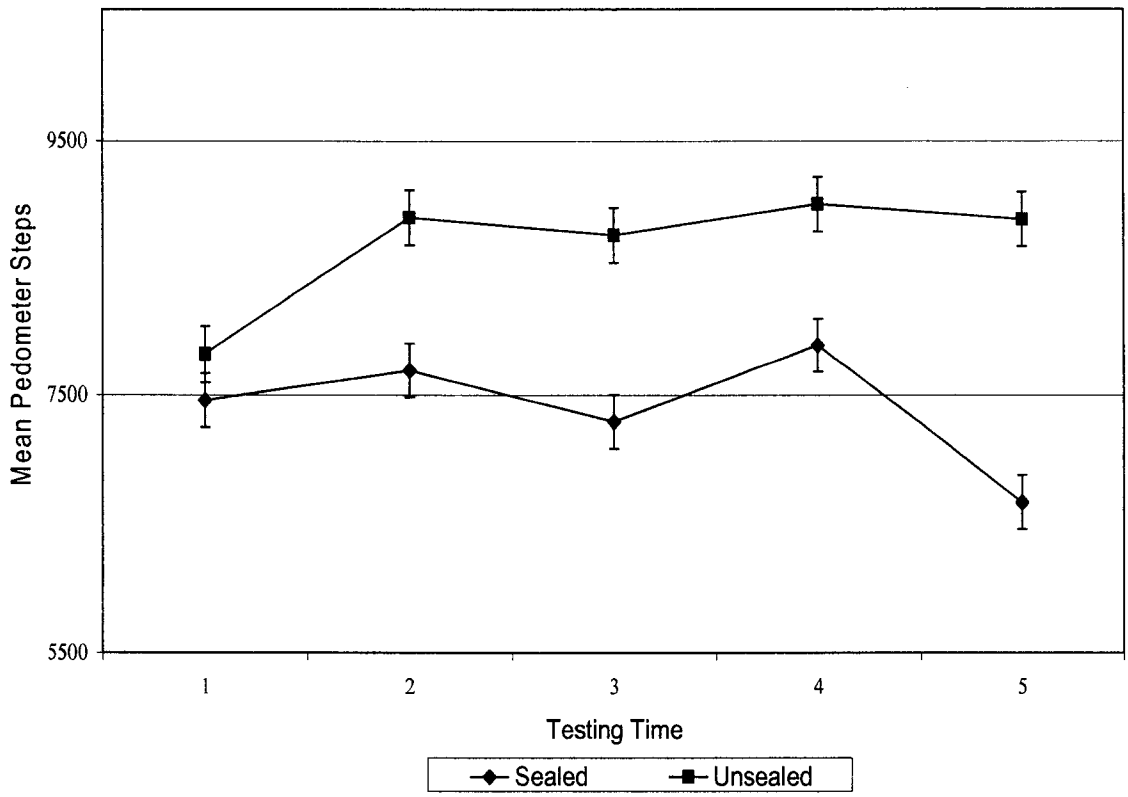

Figure 7. Means plot of pedometer steps for split control group.

collapsed into one control group and an RM-ANOVA between the intervention group and combined control groups was performed to determine if there was a time × group interaction effect. The groups also were combined to make it more difficult to detect a difference in steps as the unsealed pedometer group inflated the number of steps taken by the control group overall. Significant results indicated the intervention increased physical activity.

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A within-subject, between-subjects repeated measures analysis of variance (RM-ANOVA) was conducted to evaluate the effect of time and group on level of physical activity. The dependent variable was mean pedometer steps measured before the intervention and during each week for the next 4 weeks. The between-subjects factor was the group with two levels (intervention and control). The assumptions of sphericity and homogeneity of variance were not met; therefore, the time × group interaction effect (Hypothesis 1) was tested using both the multivariate criterion of Wilk's λ and the univariate criterion of Greenhouse Geiser.

There were significant differences in mean pedometer steps during Week 1, Week 2, Week 3, and Week 4 between women in the control and the intervention groups, Wilk's $\lambda = .785$, $F(4,107) = 7.33$, $p = .001$; $F(2.8) = 13.8$, $p = .001$. The multivariate effect size (η^2) was .22; the univariate η^2 was .11. This means that the group and time interaction effect of the sample explain 11% to 22% of the variance in the variable of physical activity. Green and Salkind (2003) state that small, medium, and large effect size for univariate η^2 are .01, .06, and .14, respectively. Therefore, effect size for this test was medium to large. Observed power for this test was 99% to 100%.

The intervention group increased their mean steps by 38.8% overall, while the control group increased their mean steps by only 2.1%. When the control group was separated into sealed and unsealed pedometer groups, the unsealed pedometer group increased their steps by 13.7% overall. A paired *t*-test indicated that for the 30 participants in the unsealed pedometer control group, the mean pedometer steps at Time 2 (M = 8896), was significantly greater than the mean pedometer steps at Time 1 (M = 7812)

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[$t(29) = 2.5, p = .017$]. In subsequent weeks, they maintained their steps near that level of physical activity but did not continue to significantly increase it. In contrast, the sealed pedometer group decreased their mean steps by 10.4%. Again, activities at the university may have influenced these steps but since there were no statistical differences in the sealed pedometer group, it can be hypothesized that knowledge of their steps may have influenced the activity level of the unsealed pedometer group. One explanation of this may be that wearing a pedometer and recording one's steps increases physical activity level.

The intervention group, however, consistently increased their steps each week of the study with the greatest increase occurring from Time 1 to Time 2 (18.7%). Reasons for this increase, other than goal setting and monitoring, may be that participants were involved in activities related to Greek Rush Week, hikes in area national parks hosted by SUU's Outdoors and Recreation Center, and a dance given by the Latter-day Saints (LDS) campus ministry.

Table 13 presents the sample sizes, means, standard deviations, and percent change for the split and combined control group and testing times for pedometer steps. Table 14 presents the sample sizes, means, standard deviations, and percent change for each group and testing times for pedometer steps. Table 15 presents results of the analysis of variance test for pedometer steps for both the multivariate and univariate tests.

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Table 13

Means, Standard Deviations, and Percent Change of Mean Pedometer Steps for Split and Combined Control Group and Five Testing Times

	Group								
	Sealed pedometer (n = 29)			Unsealed pedometer (n = 30)			Combined control groups (n = 59)		
Time	*M*	*SD*	% change	*M*	*SD*	% change	*M*	*SD*	% change
1	7457	2814		7812	2760		7638	2768	
2	7686	2557	3.1%	8896	2961	13.9%	8301	2813	8.7%
3	7291	2718	-2.2%	8757	2980	12.1%	8036	2880	5.2%
4	7884	2330	5.7%	9004	2968	15.3%	8453	2710	10.7%
5	6678	2815	-10.4%	8886	3724	13.7%	7800	3864	2.1%

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Table 14

Means, Standard Deviations, and Percent Change of Mean Pedometer Steps for Group and Five Testing Times

	Group							
	Intervention				Control			
Time	*N*	*M*	*SD*	% change	*N*	*M*	*SD*	% change
1	53	7717	1797		59	7638	2768	
2	53	9161	2198	18.7%	59	8301	2813	8.7%
3	53	9817	2497	27.2%	59	8036	2880	5.2%
4	53	10,295	2526	33.4%	59	8453	2710	10.7%
5	53	10,709	2748	38.8%	59	7800	3464	2.1%

Table 15

Multivariate and Univariate Analyses of Variance for Group by Time for the Physical Activity Interaction

	Multivariate				Univariate			
Source	df	*F*	ρ	η^2	df	*F*	ρ	η^2
Time	4	11.48	.001	.30	2.8	21.8	.001	.17
Time x group	4	7.33	.001	.22	2.8	13.8	.001	.11
Error	107				304.4			

Note: For multivariate results: *F* ratios are Wilk's approximations of *F;* for univariate results, *F* ratios are Greenhouse-Geiser approximations of *F*.

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Tests of within-subjects contrasts show a significant linear relationship between group by time interaction, $F(1) = 26.1, p = .001$. Figure 8 illustrates the mean plot of steps over time by group.

A series of analysis of variance tests were conducted to evaluate for whom the intervention worked. Post hoc tests revealed that the intervention was most successful for students aged 26 to 34 [$F(1, 52) = 4.56, p = .04$], who lived alone in a house or apartment [$F(3, 53) = 3.91, p = .01$], and were enrolled for 16 or more credit hours [$F(2, 53) = 4.09, p = .02$]. Other demographic factors or receiving academic credit did not affect participants increasing their physical activity behavior. That is, BMI, year in college, major in college, or receiving academic credit did not affect participants increasing their physical activity behavior. Figure 9 illustrates the number of participants who met and did not meet their step goal for each week of the intervention. Whether or not the participant was receiving academic credit for participating in the study also is provided.

Overall, participants in this study took fewer mean steps on Tuesdays. Mean steps for the days of the week are shown for the intervention group in Figure 10 and the unsealed pedometer control group in Figure 11.

Several participants in the intervention group failed to meet their step goals by only 1 day. The number of days the participants met their step goal for each week of the intervention is presented in Figure 12.

Finally, the number of weeks participants met their step goal was determined (Figure 13). Fourteen (14) women (23%) met their step goals for 3 of the 4 weeks of intervention. Only 10 women (2%) met their step goal for all 4 weeks of the intervention.

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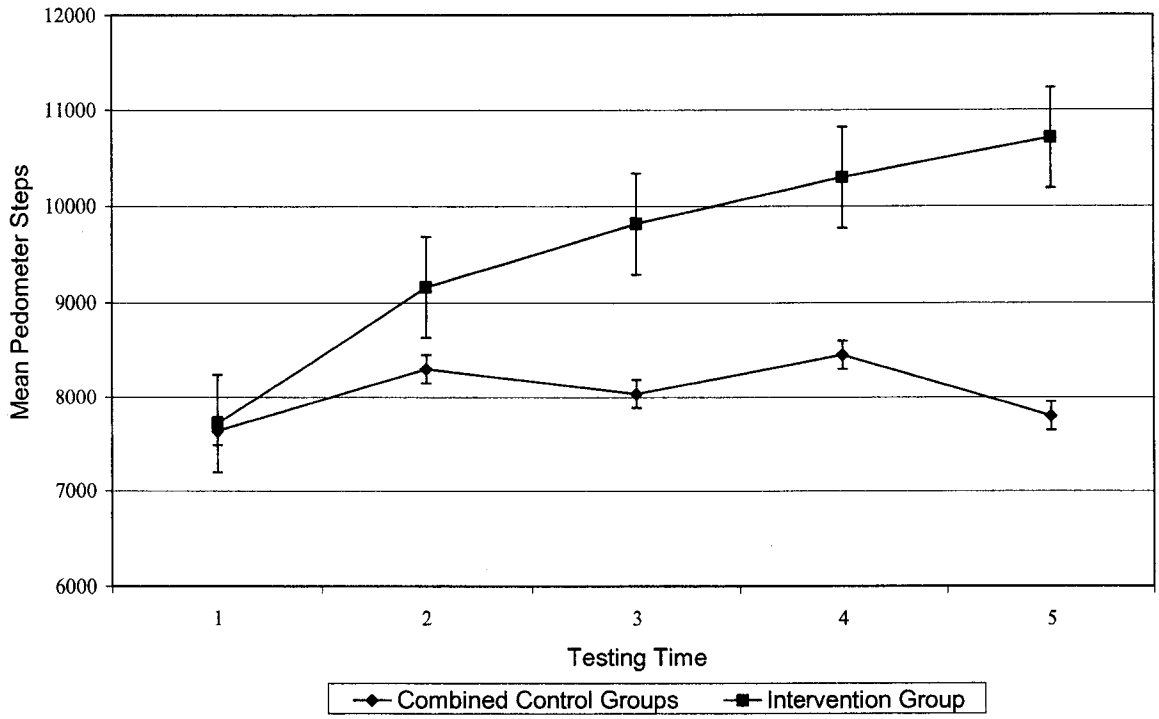

Figure 8. Means plot of steps over time by group.

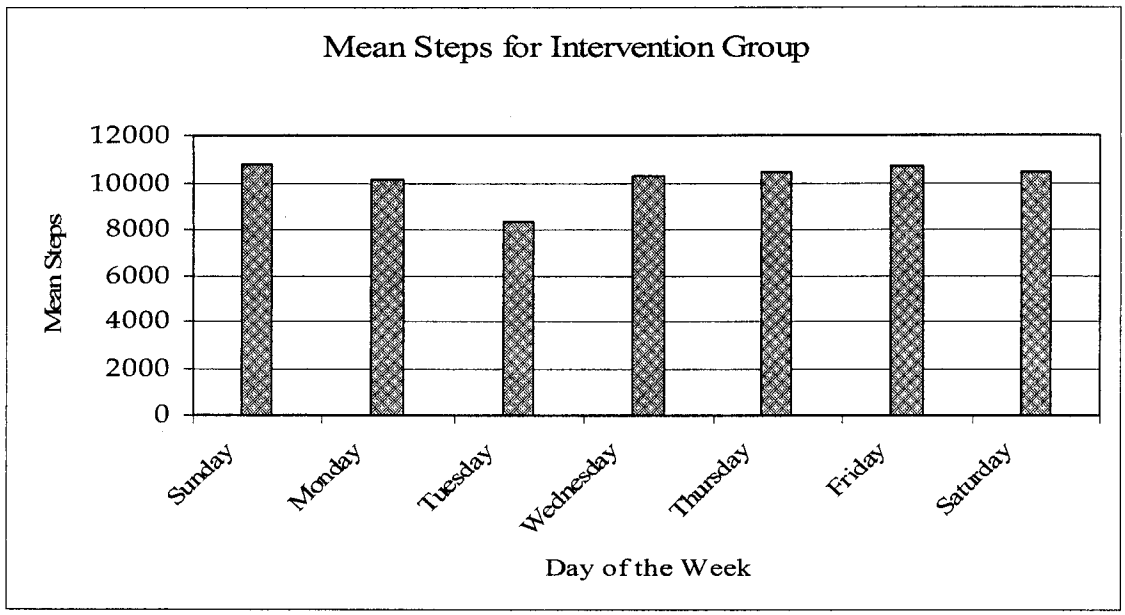

Figure 9. Mean steps for each day of the week of the intervention group.

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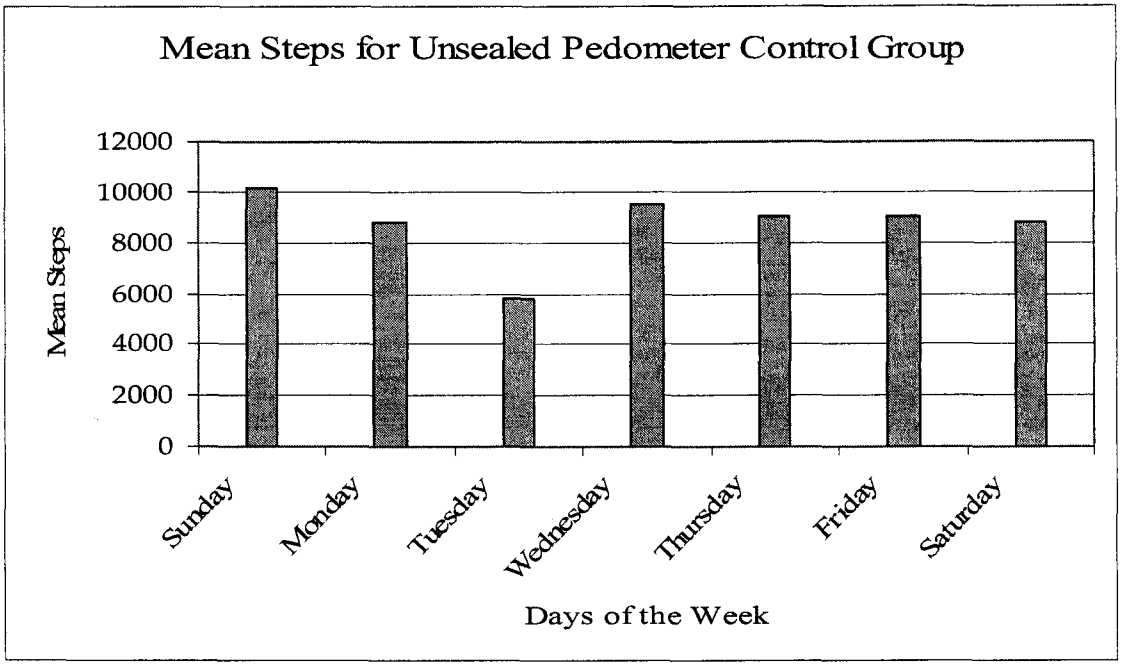

Figure 10. Mean steps for each day of the week of the unsealed pedometer control group.

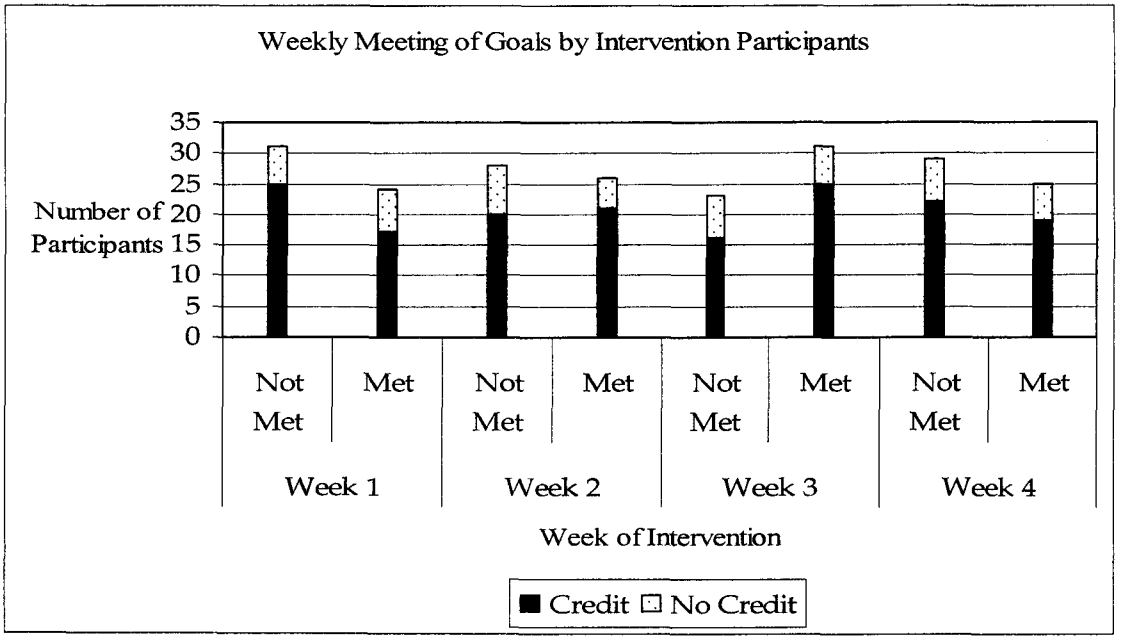

Figure 11. Weekly meeting of goals by intervention participants.

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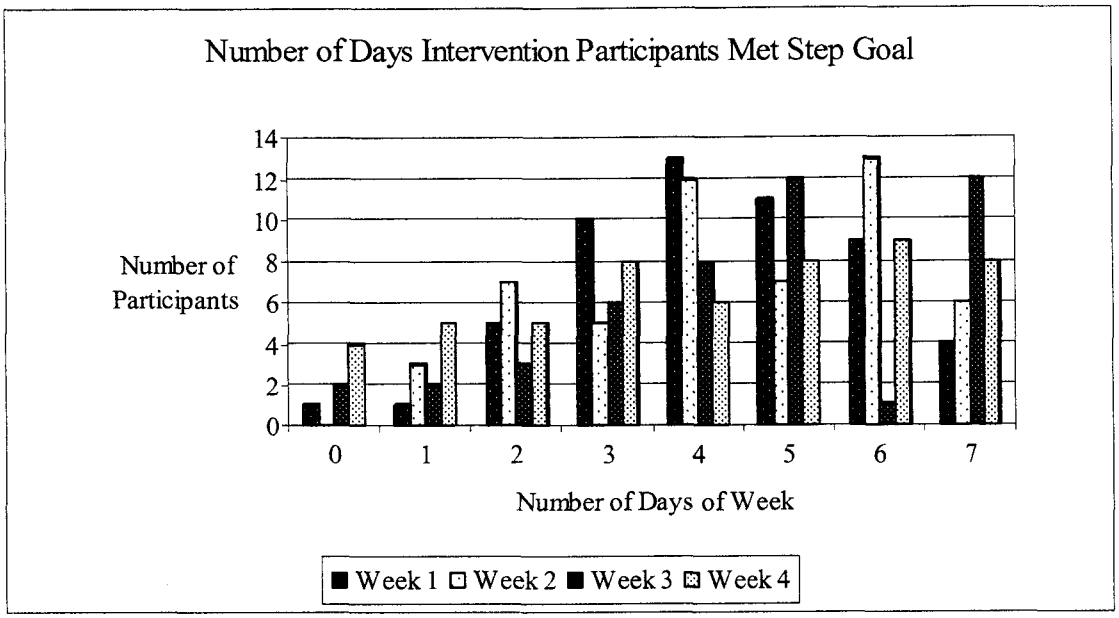

Figure 12. Number of days intervention participants met step goal.

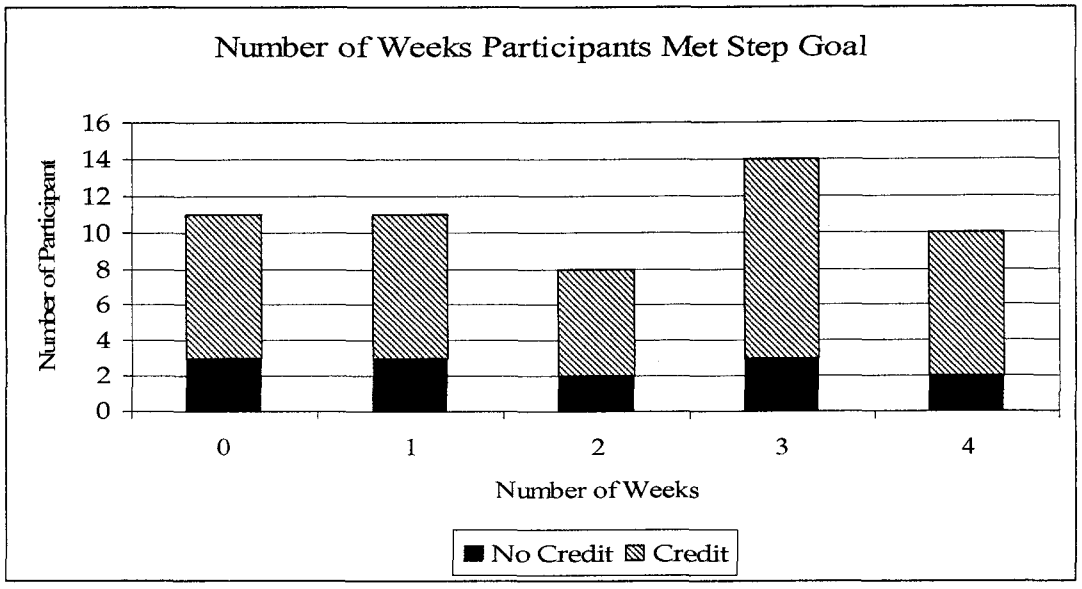

Figure 13. Number of weeks participants met step goal.

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Purpose 2

Purpose 2 was to use a process evaluation to assess the effectiveness of the intervention's implementation in terms of increasing physical activity, including the exploration of a potential mediating variable that explains changes in health behavior.

Hypothesis 2

Increased self-efficacy will mediate the relationship between the intervention and physical activity in college-aged women who are exposed to a Web-based physical activity intervention (SUU Women on the Move Walking Program).

Mediation of the Physical Activity Intervention

There were no missing data for the self-efficacy scales. Difference scores were computed for the dependent variable of physical activity (mean steps at Time 5 – mean steps at Time 1) and the mediator of self-efficacy (mean score at Time 2 – mean score at Time 1). The correlation matrix and descriptive statistics for the mediation analysis are shown in Table 16. Bivariate correlations were significant between physical activity and self-efficacy ($r = .274$, $p = .003$). The results of this test indicate that although participants with higher self-efficacy had greater levels of physical activity, this relationship was weak. That is, 7% of the variance in the womens' physical activity level could be explained by self-efficacy. Point biserial correlations were significant between self-efficacy and group membership ($r = -.265$, $p = .005$) and between physical activity and group membership ($r = -.444$, $p = .001$). That is, participants in the intervention group had significantly higher self-efficacy ($r^2 = .55$) and greater levels of physical activity ($r^2 = .88$), these relationships were strong and very strong, respectively.

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Table 16

Correlation Matrix and Descriptive Statistics for Mediation Analysis

	Group		Self-Efficacy		Mean Steps	
	r	*p*	*r*	*p*	*r*	*p*
Group			-.265	.005	-.444	.001
Self-Efficacy	-.265	.005			.274	.003
Mean Steps	-.444	.001	.274	.003		

Note. Values for group are 0 for intervention and 1 for control.

The data were checked for meeting the assumptions of multiple regression analysis, including normality, multicollinearity, independence of errors, and homoscedasticity. Self-Efficacy change scores were normally distributed, whereas the mean steps change scores were only slightly positively skewed (+2.44). Tolerance values were 1.0, .929, and 1.0 for the three multiple regression equations indicating good multicollinearity of the variables. Durbin-Watson tests for independence of errors were 1.75, 2.43, and 2.17 for the three multiple regression equations. Values from 1.5 to 2.5 are considered good; therefore, this means that the values of one observation were not related to the value of another observation. A scatter plot of studentized residuals against predicted values of the mean steps change score revealed that there was no pattern present in the data and the assumption for homescedasticity was met.

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Multiple Regression Analysis Where the Group Membership (IVP)
Predicts the Pedometer Steps (DV) (Path c)

Mean pedometer steps were first regressed on group membership, $F(1) = 26.94$, $p = .001$. The sample multiple correlation coefficient (r) was .444, indicating that about 20% of the variance in physical activity was explained by group membership. The regression coefficient for group membership is statistically significantly different from zero (B = 2830, $\beta = .444$, $p = .001$). The direction of the beta weight indicates that participants in the intervention group were more likely than participants in the control group to be physically active.

Multiple Regression Where the Group (IV) Predicts the Mediator
(self-efficacy) (DV) (Path a)

Exercise Self-Efficacy was next regressed on group membership, $F(1) = 8.38$, $p = .005$. The sample multiple correlation coefficient (r) was .265, indicating that about 7% of the variation in exercise self-efficacy is explained by group membership. In addition, the regression coefficient for self-efficacy is statistically significantly different from zero (B = .757, $\beta = .265$, $p = .005$). The direction of the beta weight suggests that participants in the intervention group were more likely than participants in the control group to have a high self-efficacy score.

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Multiple Regression Analysis Where Group (IV) Variable and
Self-Efficacy (mediating variable) Predict
Physical Activity (DV) (Path b)

The third equation regressed physical activity (dependent variable) on both exercise self-efficacy (mediating variable) and group membership (independent variable), $F(2) = 15.64, p = .001$. The sample multiple correlation coefficient (r) was .472, indicating that about 22% of the variance in physical activity was explained by exercise self-efficacy and group membership. The regression coefficient for group membership is statistically significantly different from zero (B = 2544.5, $\beta = .399, p = .001$) and the regression coefficient for exercise self-efficacy is statistically significantly different from zero (B = 373.7, $\beta = .168, p = .029$). That is, for every 1-point change in self-efficacy, there were 373 more steps taken. Finally, using unstandardized regression coefficients (B) and standard errors (se) derived from the multiple regressions performed above, the Sobel *t*-test was computed, $t(112) = 1.61, p = .053$. These results show that the intervention contributed to an increase in physical activity level; furthermore, exercise self-efficacy mediated 2.2% of the outcome. Therefore, partial mediation occurred as the data are consistent with the hypothesis that self-efficacy mediates the intervention to increase physical activity. Table 17 contains the results from the multiple regression tests. Figure 14 illustrates the final model.

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Table 17

Multiple Regression Tests

Path	Description	B	β	se	ρ
a	variable→dependent variable (mediator)	.757	.265	.262	.001
b	independent variable & the mediating variable→dependent variable	373.7	.168	194.6	.029
c	independent variable→dependent variable	2830	.444	545.2	.001

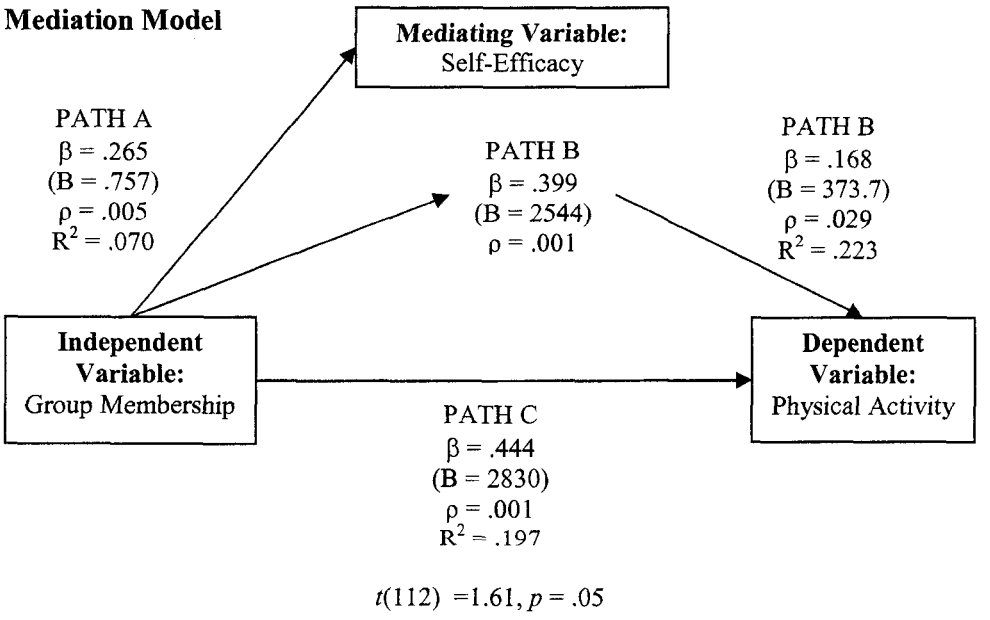

Figure 14. Explanation of mediation of self-efficacy and physical activity.

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Research Question 2A

According to participants, what social, economic, and environmental factors contributed to participation in the SUU Women on the Move walking program?

Factors Contributing to the Extent Women Participate in the Walking Program

Questions related to factors that play a role in women walking were posted on the bulletin board within the Web-CT program. Twenty (20) of the 60 participants in the intervention group responded to these questions for a response rate of 33%. Environmental conditions were reported most frequently as the factor contributing to whether or not these participants walked. Eight participants (13%) wrote that they do not like to walk when the temperature is too hot or too cold. One participant stated she does not like to get "sweaty and stinky" while walking on hot, sunny days. Another participant found that shady sidewalks were a positive factor in her walking on hot, sunny days. Two participants (3%) reported that they do not like walking on windy days.

Weather conditions were monitored daily during the intervention. Table 18 contains data on the average temperature, relative humidity, wind speed, and precipitation reported for each week of the intervention. Economic factors (time, money) affected walking in both positive and negative ways. Within this category, competing demands for time was the second most frequent reason given for interfering with walking. Sedentary jobs, 9-hour class days, and homework assignments were some

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Table 18

Weather Conditions During the Physical Activity Intervention

	Temperature (F)		Humidity (%)		Wind (mph)	Precipitation
Week	Range	*M* ± *SD*	Range	*M* ± *SD*	*M*	Days >trace precipitation
1	71 – 80	74.4 ± 3.31	13 – 42	24.7 ± 9.83	11.4	0
2	75 – 82	77.9 ± 3.08	12 – 31	17.7 ± 6.82	10.0	1
3	64 – 82	74.0 ± 5.57	11 – 46	24.7 ± 12.5	15.0	1
4	57 – 79	71.0 ± 9.57	7 – 25	18.1 ± 6.31	12.0	0

of these demands on students' time. One competing demand was the beginning of a new season of television shows. Transportation issues affected walking in a positive manner. Two participants (3%) noted that they either did not own a car or it was in need of repair. One participant (1%) stated that the price of gasoline was a powerful incentive to park her car and walk.

Six participants (10%) described the opportunity to socialize as greatly influencing whether or not they walked; they did not like walking alone or "walking for the sake of walking." Four participants (6%) claimed they lacked motivation to walk on weekends, especially Sundays. One participant (1%) said, "During the weekend, I enjoy being at home and vegging after a long week at school." Table 19 describes the factors affecting walking.

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Table 19

Factors Affecting Walking (n = 20, 33% of the Intervention Group)

Category	Factor	Examples	*N*	%
External	Weather	Temperature too hot or cold gusty winds; snow	10	17
	Time of day	Too dark.	2	3
Economic	Competing demands	Sedentary job; school (homework, time spent in classroom); TV (new season)	7	12
	Transportation	Don't own car; car is broken; price of gas	3	5
Social	Friends	Don't like to walk alone; want friends to walk with	6	10
Internal	Physical health	Fatigue, lack of energy, good health, knee pain	4	7
	Lack of motivation	Sunday, weekends	4	7
	Mental health	Mood	3	5

Strategies Used to Meet Walking Goal

Nineteen (19) participants (32%) in the intervention group used a total of five strategies on a regular basis to increase walking activity. The most important strategy used was to create more opportunities to walk. Participants walked more by parking farther away from the campus, places of employment, or stores; walking to and from the campus; and walking around the house or apartment during commercials when watching television. Table 20 summarizes the strategies used to increase daily walking activity for the sample.

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Table 20

Strategies Used to Meet Walking Goal (n = 19, 32% of the Intervention Group)

Category	Examples	*N*	%
Create opportunities to walk	"I don't use my car. I walk to and from school." "I walk back to the dorm in between my classes." "I walk around my apartment complex with a friend and visit others." "I walk around the house during TV commercials." "I park farther from the school and walk."	12	20
Finds someone to walk with	"I find friends to walk with me."	2	3
Scheduling	"I write down all the errands I can do within walking distance, and do them."	1	1
Monitor progress.	"I use the pedometer to determine how much more I need to walk."	1	1
Walks dog and horse	"My dog needs to walk twice a day and my horse hurt his foot and needs to be walked daily."	1	1

Factors Encouraging Participants to Walk

At the beginning of the study, 20 participants (33%) described several social, economic, or environmental factors that encouraged them to walk. Factors related to social opportunities and support were most frequently given as reasons to maintain a walking program. Eight participants (13%) stated they were encouraged to walk to a destination when they had friends to walk and talk with. Likewise, 5 participants (8%) walked because it helped them to meet their goal of steps/day. Table 21 summarizes the reasons participants were encouraged to walk.

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Table 21

Reasons Participants were Encouraged to Walk, (n = 20, 33% of the Intervention Group)

Factor	Example	*N*	%
Social opportunity and support	"I walk more if I am walking with someone and talking." "I am more encouraged to walk if I have a friend with me." "My daughter is loving the trips to the park." "My husband expects me to stay healthy and fit."	8	13
Goal attainment	"I would feel guilty if I didn't meet my goal." "Wearing the pedometer helps me walk more to get more steps."	5	8
Health benefits	"I want to reinforce the healthy lifestyle from summer." "I know that I need to exercise." "I want to become healthier and more active." To relieve stress: "Walk when I need a break from roommates, homework, or any other challenge." To relieve boredom: "Walking as something to do."	5	8
Enjoyment	"I enjoy walking." "I enjoy walking at night and looking at the stars." "I like to walk to the least populated places on campus and enjoy nature."	4	6
Economic	"No car." "Having a destination. Not just walking for the sake of walking."	3	5

Factors Discouraging Participants to Walk

At the beginning of the study, 20 participants (33%) identified a number of motives not to increase walking activity. Internal factors, such as energy level and motivation, were most frequently given as reasons not to walk. One participant (1%) stated she was dissuaded from walking on days she felt "drained." External factors, such as bad weather and darkness at night, and time constraints also were given as reasons not to walk. Table 22 summarizes the reasons participants are discouraged from walking.

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Table 22

Barriers to Walking (n = 20 [33%] of the Intervention Group)

Barrier	Example	*N*	%
Internal	Physical health: too tired, sweaty, "drained" Lack of motivation/preference: lazy; don't like to walk; don't like to walk on weekends or Sunday	15	25
Time constraints	Competing demands: classes; homework assignments; work; TV	9	15
External	Weather too cold, too hot, too windy Time of day: Too dark	8	13
Lack of Social Support	No one to walk with; argument with significant other	3	5

Research Question 2B

According to participants, what factors contribute to successfully recruiting college-aged women to participate in the SUU Women on the Move walking program?

Recruitment of Sample

The number of women approached by the researcher in classes or orientation groups was 1436. Participants were also recruited using posters, flyers, newspaper ads, and email solicitations. Two hundred and ten (210) women expressed interest and were eligible to participate in the study. The number of women consenting to participate in the study was 121. Therefore, the number of potential participants compared to actual participants was 57.6%. Since recruitment of volunteer samples yields a highly select

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group and there is no way to know the number of females who did not volunteer, results of this study cannot be generalized beyond the characteristics of this sample.

Attrition of Sample

Attrition rate was calculated at end of study. Nine students either dropped out or did not complete the study for an attrition rate of 7.4%. Within the intervention group, 11.6% of participants dropped out or did not complete; within the control group, 3.2% of the participants dropped out of the study.

Methods Used to Recruit Sample

Forms of recruitment, such as flyers, posters, newspaper ads, and the classes approached with recruitment script, were catalogued as to number and location. Flyers were distributed to students after classes, during orientation, and in student conferences. A flyer was included in the orientation packet and in letters to incoming nursing students. Newspaper ads appeared in the campus newspaper, *University Journal*, twice (4/15/05 and 4/19/05) during Spring Semester, and an article describing the study was printed in the newspaper, *University Journal*, on April 25, 2005. Posters were displayed in student dormitories (25 locations), an auditorium (1 location), student centers (3 locations), and various classroom buildings (Multipurpose Center [2 locations], Science Building [4 locations], Electronic Learning Building [2 locations], and General Classroom Building [3 locations]). The forms of recruitment are summarized in Table 23.

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Table 23

Forms of Recruitment

Method	Number
Flyers	400
Newspaper Ads	2
Posters*	70
Classes visited	30
Student Orientations	13
ISP Conferences	8
Email Messages	200
Newspaper Article	1

* Posters were removed every 2 weeks by university officials, and I had them replaced.

Reasons Participants Enrolled in the Study

Questions were asked of all of participants as to the reasons they signed up for this program. The most common reason for participating was the desire to become more active and develop a healthier lifestyle. Nineteen (19) participants stated that they wanted to participate in or help out in a research study. Ninety-nine (99) participants enrolled in the study elected to receive academic credit as an incentive by enrolling in Independent Study in Biology. Thirteen (13) of these (13%) declined to sign the informed consent and did not participate. Of the 86 students participating in the study for academic credit, four did not complete the study. Interestingly, only 24 (20%) of participants gave academic

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credit as a reason for participating. Table 24 summarizes the reasons given for participating in this study.

Most Effective Methods of Recruitment

Participants were asked what they thought were the most effective methods of recruitment (poster, visits by program director, brochure) used for this program. The most common method reported was a visit from me to their class or orientation session. Table 25 summarizes effective methods of recruitment.

Table 24

Reasons Given for Enrolling in Study (n = 121)

Category	Examples of participant responses	n	%
Desire to increase physical activity level	Be more active; get into better shape; be more healthy; lose weight; get motivated	76	62.8
Fun	Sounded like fun; sounded like an interesting study; curious about the study or walking; had time to participate; enjoys walking	26	21.5
Incentives being offered	Earn academic credit	24	19.8
Personal awareness	Find out my personal step count; aware that own physical activity level was low	23	19.0
Volunteer (give support)	Wanted to help out	19	15.7
Values health and wellness	Aware of importance of physical activity; knew benefits of being physically active	8	6.6
Get involved	Get out of the house and do something; socialize with friends	5	4.1

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Table 25

Most Effective Recruitment Methods (n = 121)

Category	n	%
1. Visit by the researcher to class, orientation, club, etc.	90	74.4
2. Posters located around campus	37	30.6
3. Flyers (hand-outs in classes, orientation, letters to students)	15	12.4
4. Word-of-mouth	10	8.3
5. E-mailed announcement of walking program	6	5.0
6. Article in campus newspaper	2	1.7
7. Incentives offered	2	1.7

Suggestions for Incentives

Participants were asked what suggestions they had for incentives that would be better or more useful to them. Most often, they gave examples of incentives that were already being used, such as gift certificates and academic credit. Within the money category, 3 participants suggested scholarships or book scholarships as a good incentive to participate in the study. Suggestions for incentives are summarized in Table 26.

Research Question 2C

According to participants, what program factors contribute to keeping college-aged women actively involved in the SUU Women on the Move walking program?

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Table 26

Incentive Suggestions for a Physical Activity Program (n = 121)

Category	Examples	n	%
1. Money	Gift certificates; shopping cards; cash; money for textbooks; scholarships	24	19.8
2. Free academic credit		12	9.9
3. Work-out paraphernalia	Pedometer; water bottle; T-shirt; free passes to gym	6	5.0
4. Food	Free food; parties every month	5	4.1
5. Movie tickets		2	1.7

Attendance Data for the Physical Activity Intervention

Attendance at the various events during this study was recorded. The following data were collected: (1) attendance at pretest data collection, (2) attendance at posttest data collection, (3) attendance of intervention group at Web-CT training sessions, (4) attendance at weekly data collection for the sealed pedometer control group during the intervention period, (5) log-in information of intervention group participants to Web-CT, (6) submission of goals and weekly steps taken by intervention group participants, and (7) submission of recording sheets by unsealed-pedometer-control group. Descriptive statistics were used to describe the data.

Attendance at data collection times was high at the beginning of the study and decreased as the study continued. The control group was the most consistent in attending data collection times. Table 27 presents information on the attendance of participants during data collection.

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Participants' Use of Website

Patterns of use of the Website differed among participants. Over the 4-week trial period, 95% of participants (n = 60) visited the Website. There were a total of 3812 'hits' recorded to the Website. There was no significant relationship between the number of times a participant logged into the Web-CT program and difference in mean steps/day. Table 28 summarizes the participation of the intervention group with the Web-CT program.

Assignments to view content modules were posted weekly on the Web-CT Walking Intervention bulletin board. During the 1st week, participants were to view the modules on lifestyle physical activity, how to use a pedometer, monitoring your progress, and choices and strategies. During the 2nd week, participants were to view the modules on safety, benefits of walking, and identifying barriers. The modules on overcoming barriers and where to walk in Cedar City were to be viewed during the third week.

Although there were nine content modules to be viewed over the 4-week intervention, only 11 of the 60 participants in the intervention group viewed all of them (Figure 15). Figure 16 shows the frequency of content viewed as the intervention proceeded; 25 participants viewed at least one module more than once. The modules varied as to which were viewed more often. The module concerned an introduction to lifestyle physical activity was viewed 24 additional times, sometimes two or three times by 1 participant. Modules concerning monitoring progress and safety issues were viewed twice by 7 and 9 participants, respectively. The module describing places to walk in Cedar City was viewed twice by 5 participants. Modules concerned with increasing self-efficacy were "Choices and Strategies," "Identifying Barriers," and "Overcoming

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Table 27

Attendance and Submission of Materials by Participants in the Study

Criteria	Control Group		
	SP	UP	I
Attendance at baseline data collection			
Session 1	31	30	60
Session 2	29	30	59
Attendance at Web-ct training session	–	–	3
Attendance at data collection during intervention period			
Week 1	29	–	–
Week 2	29	–	–
Week 3	29	–	–
Attendance at final data collection	29	27	53

SP = sealed pedometer; *UP* = unsealed pedometer; *I* = intervention group; "–"= does not apply

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Table 28

Participation of the Intervention Group in the Web-CT Intervention

Component of the Web-CT	Number of Participants	%
Total times participants entered WebCT		
≤20	5	8.3
21 – 60	21	35.0
61 – 100	14	23.3
>100	17	28.3
Times read bulletin board		
0	11	18.3
1 – 40	36	60.0
41 – 70	12	20.0
Times posted message to bulletin board		
0	34	56.6
1 – 2	16	26.7
3 – 4	9	15.0
Submission of goals		
Week 1	56	93.3
Week 2	52	86.6
Week 3	40	66.7
Week 4	30	50.0
Submission of step-recording sheet		
Week 1	50	83.3
Week 2	43	71.7
Week 3	30	50.0

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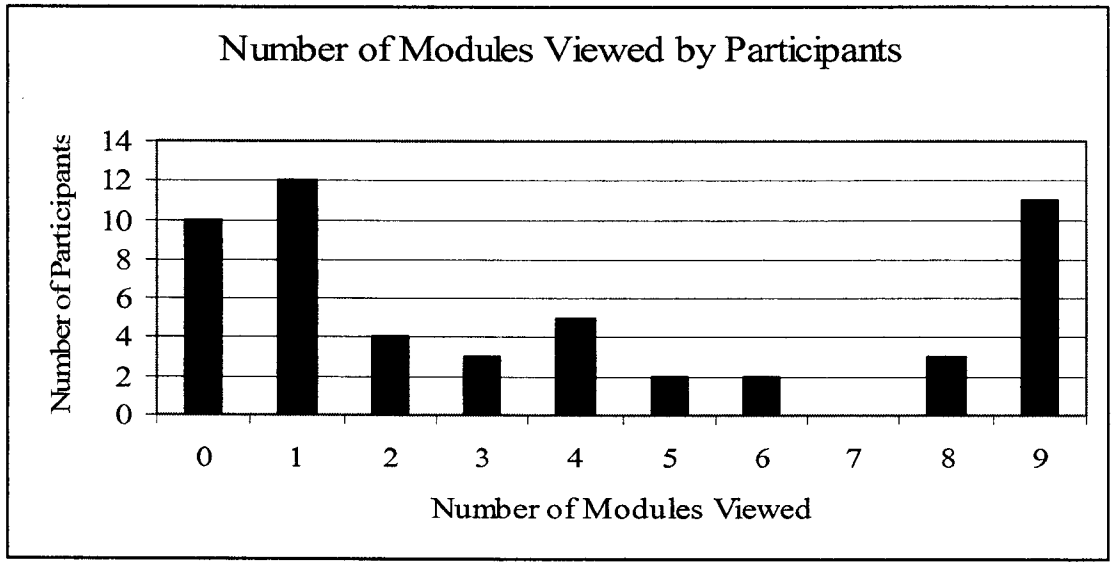

Figure 15. Number of participants who viewed from 0 to 9 content modules during intervention.

Barriers." The first module was viewed by 23 participants, twice by 2 participants; the second module was viewed by 16 participants, twice by 1 participant; and the third module was viewed by 16 participants, twice by 2 participants. Figure 17 shows the number of participants who viewed the individual modules. There were no significant relationships between modules viewed by participants or the total number of modules viewed by participants and meeting step goals. These findings indicate that the Web-based intervention was not the catalyst for increasing steps in participants.

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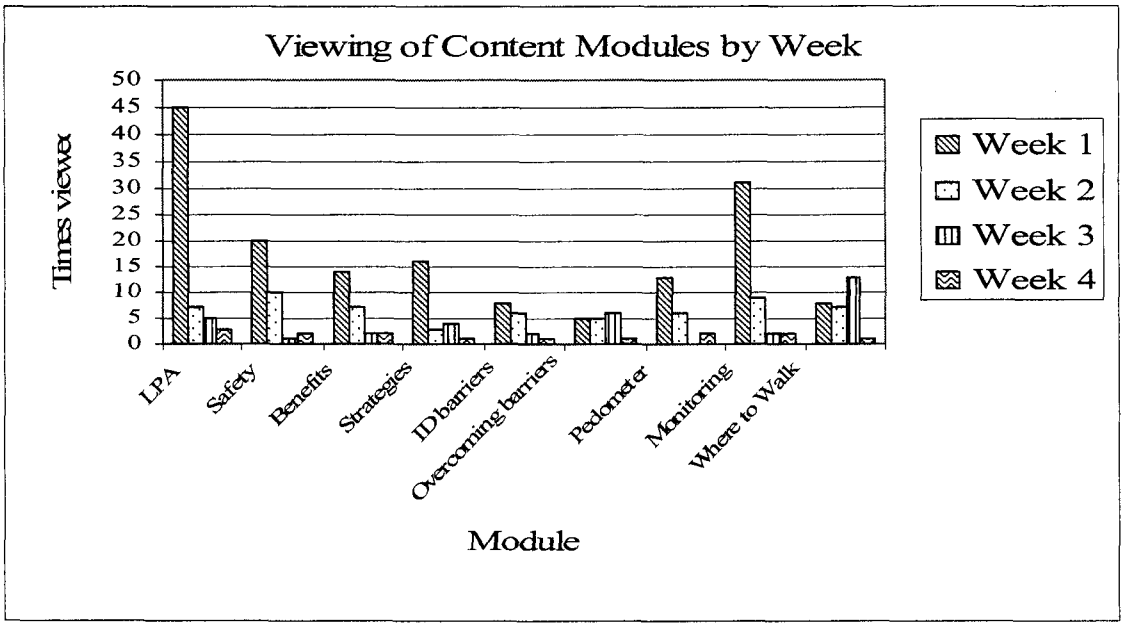

Figure 16. Number of times content module was viewed by week during the intervention.

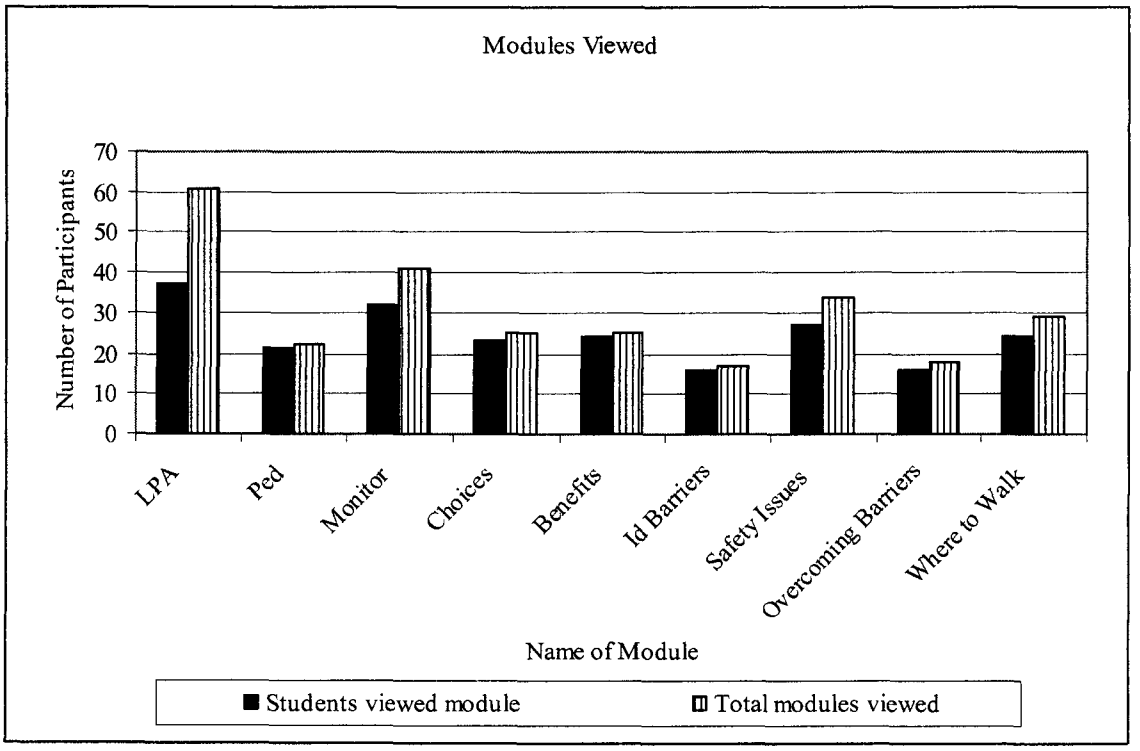

Figure 17. Number of participants who viewed content module during the intervention.

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Participants' Evaluation of the Content Modules

Each module contained a short survey to be answered after viewing the module. The survey asked how useful the information was, if it should be improved, and suggestions for improving content. Of the participants who evaluated the module, most (70% to 100%) felt no improvements were needed to the module. More of participants rated the modules as useful to very useful (25% to 91%) than somewhat useful (7% to 28%). Results of the survey are represented in Table 29.

Participant's Involvement in the Walking Program

Toward the end of the study, participants in the intervention group were asked about their engagement and retention in the program. Once again, participants were asked what encouraged them to walk. Twenty (20) participants (33%) responded to the question posted on the bulletin board. Motives described most frequently by participants were health benefits, social opportunity and support, and goal attainment. Four participants (6%) noted that the health benefits of walking helped them to continue their walking program. One participant (1%) stated she was encouraged to walk on "days when I feel good about myself and accepted by others." Another participant wrote that walking helped her to get to her classes, increasing her confidence to walk more. Table 30 summarizes the reasons given by participants at the end of the study that encouraged daily walking activity.

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Table 29

Evaluation of Content Modules in Walking Intervention

Question	Useful—very useful *N* (%)	Not at all useful—somewhat useful *N* (%)	Don't know if useful *N* (%)	No need to improve *N* (%)
Module: Lifestyle Physical Activity (*n* = 39, 65%)				
1. How useful was the information about lifestyle physical activity to you?	25 (42)	11 (18)	1 (2)	-
2. How useful was the information on getting started to you?	21 (35)	13 (22)	5 (8)	-
3. How useful was the information on how to increase the amount of walking you do?	32 (53)	5 (8)	2 (3)	-
4. Do you feel this module could be improved?				29 (48)
Module: Benefits of Physical Activity (*n* = 4, 6%)				
1. How useful was the information about the benefits of physical activity to you?	1 (2)	1 (2)	2 (3)	-
2. Do you feel this module could be improved?				3 (5)
Module: Safety Tips (*n* = 28, 47%)				
1. How useful was the information about stretching to you?	24 (40)	4 (7)	-	-
2. How useful were the safety tips?	25 (42)	2 (3)	1 (2)	-
3. How useful was the information about posture during walking?	25 (42)	3 (5)	-	-
4. Do you feel this module could be improved?				21 (35)

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Table 29 Continued

Question	Useful—very useful *N* (%)	Not at all useful—somewhat useful *N* (%)	Don't know if useful *N* (%)	No need to improve *N* (%)
Module: Choices and Strategies (n = 23, 38%)				
1. How useful was the information about lifestyle physical activity to you?	17 (28)	5 (8)	1 (2)	-
2. How useful was the information in this module in planning your walking program?	20 (33)	2 (3)	1 (2)	-
3. Do you feel this module could be improved?				19 (32)
Module: Strategies to Overcome Barriers (n = 20, 33%)				
1. How useful was the information about strategies to overcome barriers to you?	12 (20)	3 (5)	5 (8)	-
2. Do you feel this module could be improved?				14 (23)
Module: How to Wear the Pedometer (n = 23, 38%)				
1. How useful was the information on how to wear the pedometer to you?	21 (35)	1 (2)	1 (2)	-
2. Do you feel this module could be improved?				23 (38)
Module: Identification of Barriers (n = 23, 38%)				
1. How useful was the information about barriers to you?	16 (27)	4 (7)	3 (5)	-
2. How useful were the Websites dealing with barriers to you?	13 (22)	3 (5)	7 (12)	-
3. Do you feel this module could be improved?				17 (28)

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Table 29 Continued

Question	Useful—very useful *N* (%)	Not at all useful—somewhat useful *N* (%)	Don't know if useful *N* (%)	No need to improve *N* (%)
Module: Monitoring your Progress (*n* = 30, 50%)				
1. How useful was the information about how to make step goals to you?	21 (35)	6 (10)	3 (5)	-
2. How helpful was the information "how many steps are enough" to you?	24 (40)	4 (7)	2 (3)	-
3. Do you feel this module could be improved?				25 (42)
Module: Where to Walk (*n* = 27, 45%)				
1. How useful was the information on walking success to you?	22 (37)	2 (3)	3 (5)	-
2. How useful was the information on different areas in Cedar City to walk to you?	21 (35)	4 (7)	2 (3)	-
3. How useful were the links to other walking Websites to you?	15 (25)	4 (7)	8 (13)	-
4. Do you feel this module could be improved?				27 (45)

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Table 30

Reasons Participants Were Encouraged to Walk at the End of the Study

(n = 20, 33% of the Intervention Group)

Category	Examples of Participants' Responses	*N*	%
Health benefits	"I am trying to lose weight" "I notice my legs are more muscular" "I feel good when I exercise" "I would like to be more physically active" "Clearer mind "I want to be in better shape." "Getting in shape" Mood	15	25
Social opportunity and support	Friend to walk with Family/friends. Talking with someone while walking Encouragement from others (husband, roommates)	11	18
Goal attainment	The Pedometer and my step goal My step goal Pedometer (monitoring)	4	6
Purpose	Shopping Walking to and from classes	3	5
Economic	No car Not spending money on gas	2	3
Walking program	Walking as the method of physical activity The walking program	2	3
Other	Better participation in class Give myself the time (permission) Sitting in a chair all day long	3	5

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At the end of the study, participants also were asked to describe what discouraged them from walking. Twenty (20) participants (33%) identified a number of reasons not to increase walking activity. The reasons most frequently given were internal factors, such as physical health issues and lack of motivation; time constraints; and external factors, such as the weather. Personal preference issues were given as an explanation of whether or not a participant walked. Although 1 participant wrote that she was most likely not going to walk "on days when I have a lot to carry," another participant wrote that she "likes to wear high heels" which made it "difficult to walk." Two participants noted that they did not like any kind of exercise, which included walking. Table 31 summarizes the motives for not increasing daily walking activity.

Table 31

Barriers to Walking Identified at the End of the Study

(*n* = 20, 33% of the Intervention Group)

Category	Examples	N	%
Internal	Physical Health: fatigue (tired), injury/illness (not feeling well, sore knee)	17	28
	Mental Health: bad day, angry, stress, bad mood	4	6
	Lack of Motivation/Preference: forgetfulness, lazy, don't want to do anything on Sundays, don't like to walk in the dark	9	15
Time constraints	Time: no time, lack of time, faster to drive "Walking is time consuming" "It takes longer to walk" "I'm always late and don't have the time to walk"	8	15
	Competing Demands: school/homework demands, work demands, other demands	8	15
External	Weather: bad weather, cold weather	6	10
Lack of social support	No one to walk with; walking alone	2	3

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Reasons Participants Stayed Involved in the Program

Participants in the intervention group were asked what it was about the walking program that motivated them to stay involved. Twenty-four (24) participants (40%) responded to the question posted on the Website's bulletin board and reported that they were motivated to stay involved in the walking program for six reasons. The reasons given most frequently by participants were making and meeting goals and the interactivity and flexibility of the program itself. One participant stated, "It was exciting to look at the recording sheet and see my improvement week by week." Table 32 summarizes the motivations given to stay involved in the study.

Participants also were asked what it was about the walking program that discouraged their involvement. Twenty-four (24) participants (40%) were challenged to stay involved in the walking program for five reasons. The reasons most frequently given by participants were: lack of time, personal preferences or motivation, and physical health issues. One participant wrote, "I wanted to walk to work but I never had enough time to walk there and then it was dark when I got out." Two participants stated that nothing discouraged them from participation in the intervention. Table 33 summarizes reasons that discouraged participants from staying involved in the study.

Participants' Evaluation of the Intervention

The intervention group was asked to evaluate the intervention related to the use of the computer and strengths of the program. Only 21 responses (18% of the Intervention Group) were submitted. Suggestions for improving the walking program and their overall feelings concerning the program were also sought. Overall, most of the participants

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Table 32

Motivations to Stay Involved in the Study (n = 24, 40% of the Intervention Group)

Category	Examples	*N*	%
Goal attainment	"Curious to see if I could meet my goal" "Having to make goals and then meeting them." "Emails about meeting my goals from the researcher." "Excited about reaching my goal."	7	12
Walking program	"Interaction through the modules and emails" "Researcher's understanding and flexibility when I don't meet my goal." "Ease of recording steps and goals on WebCT" "Flexibility of the computer program."	6	10
New knowledge	The program has given me good information. Learning about my personal physical activity level. Gave good tips on walking Modules gave new information Awareness of my physical activity level.	5	8
Health benefits	"To better my future chances of staying healthy and active." "I'm exercising and trying to lose weight." "I feel better about myself when I've walked." "I feel healthier."	4	6
Incentives	The incentives. Academic credit.	4	6
Other	Because I agreed to do the study Gives me an excuse to go hiking with friends. Personal motivation. Fear of the "Freshmen Fifteen"	4	6

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Table 33

Reasons That Discouraged Participants From Involvement in Study

(n = 24, 40% of the Intervention Group)

Category	Examples	*N*	%
Lack of time/competing demands	Lack of free time Poor skills at scheduling Homework demands.	7	12
Personal preferences/ motivation	"I didn't want to walk on weekends" "I refuse to walk at night." "My own laziness." "Learning about what was involved in the intervention at first (overwhelmed). I didn't think I could do it."	5	8
Physical health	Illness (headaches) Unexpected injury (hip) Tiredness	3	5
Failure to meet step goal	"When I check the pedometer and know I am not going to meet my goal.	2	3
Lack of equipment	"I don't have headphones, so it was hard to hear the modules.	1	1

(11 of 21 responses) stated that using the computer was easy, convenient, and made the walking program accessible. One participant stated:

> I actually love this computer program. It makes it very easy to record my data and to keep track of progress. I really enjoyed this study more than I thought I would, and I think it is because of the availability due to the computer.

However, 3 participants stated that they lacked the discipline to access the program in a consistent manner and another participant reported that her lack of experience with the computer affected her accessing the program for a time. Two participants liked that there were no classes to attend. One participant stated, "I liked that I didn't have to check-in

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with someone." Four participants enjoyed the e-mail and bulletin board features of the Web-CT program. One of these wrote, "I really liked that we could easily e-mail you if we had questions, and that we could see how other girls were doing or what questions they had." Strengths of the program were identified as having the walking program on the Web-CT, learning how to set goals, and using pedometers to monitor progress toward the goal.

Suggestions for improving the walking program were divided as to either how to improve the program, itself, or to increase social support among participants enrolled in the program. These suggestions are presented in Table 34.

Finally, participants were asked about their overall feelings of the walking program. Of the 21 responses, 20 participants (33%) stated that they enjoyed the program. In support of their enjoyment of the program, 9 stressed that the program motivated them to walk more. One participant wrote, "It really inspired me to get out and do something. I got hooked on golfing and it's a new sport that I absolutely love and I probably never would have tried it without this intervention." Another wrote, "I liked it. It provided me some motivation to walk more. I more then doubled the amount of times I take the stairs, instead of the elevator!"

Nine participants credited the walking program for increasing awareness of their physical activity level. One participant wrote, "I became so much more aware of my body and the exercise I need. When I met my walking goals, I felt better all around." Another stated, "It helped me stay conscious of my physical activity throughout the day."

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Table 34

Suggestions for Improving Walking Intervention

Improving the Program	Improving Social Support
Clearer expectations as to Web-CT requirements, increasing physical activity	Circulate a list of walking buddies
Meet as a group to discuss barriers, strategies, progress towards goals, etc.	Meet as a group to socialize
Give more tips to increase walking	Meet as a group to walk (i.e., Saturdays)
Recording steps: paper is redundant if submitting steps on computer WebCT forms were not always available	
Make assignments participants have to complete, i.e., identifying their barriers and strategies to overcome them.	
Caution participants to set reasonable goals.	

Two participants enjoyed being able to determine their own goal for walking, one participant reported that it increased her confidence to be more physically active, and two participants enjoyed the modules because the information was new to them. One participant wrote:

> I enjoyed the modules; it was very interesting to learn that walking for 30 minutes is just as good an exercise than anything else, and that stretching helps decrease threats of muscle injury even when walking. It has made we want to continue to walk and even exercise more, because I feel healthier and look better, and it makes me feel good about myself.

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Summary

The innovative delivery of a theory-based, physical activity intervention to increase ambulatory activity in college-aged women had not been done before. Additionally, ambulatory activity was measured using a direct measure of physical activity, the pedometer. Findings indicated that college-aged women who received the intervention were significantly more physically active (steps/d) than women who did not receive the intervention. Self-Efficacy partially mediated the intervention to increase physical activity. Process evaluation assessed the context, recruitment, and maintenance components of the study. Overall, the walking program was enjoyed. The only frustrations reported were lack of time to participate in the program (log into Web-CT) (n = 1) and inability to meet one's step goal (n = 1).

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CHAPTER V

RESULTS AND DISCUSSION

Summary of Results and Discussion

The purpose of this experimental, repeated measures study was to use Social Cognitive Theory to design and implement an intervention (SUU Women on the Move Walking Program, administered by Web-based media [Web-CT]) to promote and increase lifestyle physical activity in college-aged women. This study also used a process evaluation to assess the effectiveness of the intervention's implementation in terms of increasing physical activity including the exploration of a potential mediating variable that explains changes in health behavior. This chapter reviews the most important findings of the study; discusses reasons why they occurred; compares findings with previous literature; addresses limitations; discusses implications for nursing practice, nursing research, and nursing education; and offers suggestions for future research.

Characteristics of the College-aged Women

Data were collected from 121 college-aged women. Data collection began on August 30, 2005, and ended on October 7, 2005, in Cedar City, UT. Of the 121 women, 95% were White and 76% were not married or partnered. The mean age was 20.6 years. Well over half (54.5%) were in their freshmen year at Southern Utah University

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(SUU) and 28.1% were majors within the College of Science. The women in this study were enrolled for an average of 14.8 credit hours for the fall semester; and 52.1% were not employed, 38% were employed part-time, and 9.1% were employed full-time while attending school. In addition, 52.9% of women reported their household incomes at less than $20,000.

It should be noted that the mean body mass index (BMI [kg/m^2]) of the women was 25.2 kg/m^2. This study found that 43% of the women were overweight or obese. In comparison, the United States reports that 65% of the population is overweight or obese (Centers for Disease Control and Prevention, 2000). Mean baseline physical activity level of these women was 7780 steps per day. That is, the women in this study were somewhat active (7500 to 9999 steps) (Tudor-Locke & Bassett, 2004). College-age women in this study had a greater mean BMI and were less active than the sample used by Behrens and Dinger (2005). Mean self-efficacy score was 5.7. This score indicates that, on average, the women felt moderately confident that they could exercise.

It is clear that participants in this study understood the value of physical activity because the great proportion (90.9%) stated that physical activity was good for their health. None of the women felt it was a male activity and only .8% felt it was a waste of time.

Results of the Physical Activity Intervention for College-aged Women

One of the most important findings of this study was that college-aged women who received the physical activity intervention were significantly more physically active (mean steps/day) than women who did not receive the intervention. The effect size was

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.11 to .22; that is, 11 to 22% of the variance in physical activity behavior was explained by the intervention by time interaction. The intervention was most successful for women who were 26 to 34 years old, lived alone in a house or apartment, and were enrolled for 16 or more credit hours. The results of this study are consistent with other physical activity intervention studies that increased physical activity in middle-aged and older women (Barrett, 2000; Cox et al., 2003; Dallow & Anderson, 2003; Maxwell et al., 2002; Nies et al., 2003; Speck & Looney, 2001; Swartz, Strath et al., 2003; Whitely, 2001; Wilbur et al., 2001; Wilde et al., 2001). Equally important, this study corrected limitations of previous studies by increasing the sample size.

In contrast to a study by Behrens and Dinger (2005), physical activity level did not decrease on weekend days. Women who were in both the intervention and unsealed pedometer groups in this study took fewer steps on Tuesdays. Additionally, this study used the current recommendations for participating in physical activity of 5 days of moderately-intense physical activity rather than previous recommendations of 3 days of vigorous physical activity. Data showed that 24 women were successful in meeting the current recommendation for physical activity for 3 or 4 weeks of the intervention. Several women who were not successful in meeting their step goal missed the goal by only 1 or 2 days of the week.

Unlike Cardinal and colleagues (2002) and Sallis and colleagues (1999), who relied on self-report methods to measure physical activity levels of college students and reported no increase in physical activity level, this study used pedometers and found increases in physical activity level. Other studies have provided evidence for the motivating effect of pedometers in increasing physical activity among those involved in

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interventions (Crouteau, 2004; Speck & Looney, 2001, Talbot et al., 2003; Wilde et al., 2001). Changes to the recording sheet after the pilot study made it easier for women to log their steps taken and times the pedometer was worn. In contrast to studies by Crouteau and colleagues (2004), this study used an experimental design and was able to discern that women in the intervention group had greater steps as measured by pedometer than those in the control group.

On the basis of these findings, it appears that pedometers, used in conjunction with goal setting and provision of important information via Web-CT, can increase women's physical activity level. This study showed that women in the intervention group increased their pedometer steps by 38% in comparison with the control group who increased their steps by 2.1%. This result is similar to findings from earlier studies (Ransdell, Robertson et al., 2004; Swartz, Strath et al., 2003; Talbot et al., 2003).

Notably, when the control group was separated into two groups of women who wore a sealed pedometer and those who wore an unsealed pedometer, the women who wore a sealed pedometer decreased their overall steps by 10.4%, whereas the women who wore unsealed pedometers increased their overall steps by 13.7%. In contrast to Eastep and colleagues (2004), this study found that wearing a pedometer and knowing one's steps did motivate participants to increase their physical activity. Women who wore unsealed pedometers were consistent in increasing their steps over baseline by 12% to 15% each week during the study. This study also showed that wearing a pedometer and having to record the number of steps taken daily had an effect on activity level. Therefore, physical activity interventions that use pedometers can effectively target this age group to promote increased physical activity levels.

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Results of the Process Evaluation for Physical Activity Intervention

Self-Efficacy as a Mediator of the Intervention

A second important finding in the study was that, along with the physical activity intervention, exercise self-efficacy partially mediated an increase in physical activity in these women. MacKinnon (1994) asserts that mediation will not occur if interventions are not successfully implemented. Results from this study are consistent with earlier research on physical activity interventions and self-efficacy (Brassington et al., 2002; Hallam & Petosa, 2004; Miller et al., 2002) in that findings showed that the intervention significantly increased self-efficacy. However, the intervention explained only 7% of the variance of self-efficacy in this study, whereas in a study by Brassington and colleagues (2002) the intervention explained 14% of the variance of self-efficacy. Therefore, although the findings from this study concur with findings from the study by Brassington and colleagues, in which self-efficacy partially mediated the intervention, 93% of the variance was unexplained. Self-Efficacy was not a strong mediator. One explanation for these results may be that the intervention was not fully implemented (i.e., students did not regularly log onto the Web-based intervention). Another explanation is that exercise self-efficacy may not be an important mediator for this group. Body image or socialization issues may be more important.

Context

One of the most important factors that contributed to walking in a few of the women (13%) in this study was the weather. However, these findings do not provide data confirming whether or not weather conditions affected women's walking habits. No

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studies have specifically described the relationship between the weather and physical activity. This relationship needs further research to determine if weather patterns affect the amount of walking one does.

Some evidence suggests that safety concerns were another reason given for not being physically active. In a paper by Ransdell, Vener et al. (2004), safety concerns were identified as crime, loose dogs, and lack of sidewalks. This study identified time of day (darkness) as an additional reason women (3%) do not walk because of safety concerns.

Other factors that contributed to 4% of the women failing to walk were the occurrence of fatigue and illness. At the beginning of the study, these women reported that these issues were their greatest barriers to walking. Hectic work and school schedules may have lead to fatigue. Many of the women reported having frequent headaches and bouts with stomach and flu-like symptoms, and a few women stated that they found it difficult to walk when they were depressed. These findings suggest that college-aged women experience symptoms of increased stress as a student and this stress affects their physical activity level.

Some women in this study reported a lack of motivation to walk; no attempt was made to determine if motivational level affected walking behavior. Other studies provide evidence for lack of motivation as a common reason given for physical inactivity (Grubbs & Carter, 2002; Jaffe et al., 1999; Makrides et al., 1998; Yoshida et al., 1988). One explanation for their lack of motivation may be that these women did not like to walk for leisurely entertainment. They enjoyed walking if they had a destination with a purpose and preferred to chat with a friend walking with them. Additionally, a few women in this study reported that weekends, especially Sundays, were difficult days on which to walk

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because they wanted to relax or had no reason to walk. However, in examining mean steps for each day of the week, there were no fewer steps taken on weekends as compared to the weekdays. These findings were in agreement with a studies by Belza and Warms (2004) who found that women need a reason to exercise or walk, and Ransdell, Vener et al. (2004) who found women walk when it is fun and enjoyable.

When asked again at the end of the study, 15% of the women reported that fatigue and lack of motivation were common barriers but 27% of the women found the lack of time a greater barrier than the weather. Just as several researchers observe that women who have family and household demands are less physically active, this study found that college-aged females have similar demands on their time because of classes, work schedules, and homework (Belza & Warms, 2004; Grubbs & Carter, 2002; Jaffe et al., 1999; Ransdell, Vener et al., 2004; Yoshida et al., 1988; White, 2004).

At the beginning of the study, women were encouraged to walk when it involved a social reason (13%), goal attainment (8%), or for health benefits (8%). When asked again at the end of the study, they reported walking for health benefits (25%), social reasons (18%), or goal attainment (6%). It is uncertain what brought about the change in the frequency of these responses; however, several women stated that when they walked they felt better. Other studies provided evidence that women have an increased physical activity level when they have positive social support from family or friends (Cox et al., 2003; Lombard et al., 1995).

The strategies women used to increase physical activity focused on creating more opportunities to walk by changing habits related to car use, parking, and seeking out social occasions that involved walking. These women reported walking to and from

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classes, from home to work, and to residences of friends. Many of the strategies were presented in the Web-CT tutorials and I also e-mailed strategies to women as they submitted their goals and steps.

On the basis of these findings, the context in which women walk should be considered when developing physical activity interventions. Environmental factors, such as the weather and time of day, appear to influence walking activity as much as social support and time constraints. Interventions should focus on ways to decrease barriers and increase social support for physical activity.

Recruitment

I spoke to 1436 women in classes and orientation sessions at SUU. Posters, brochures, newspaper ads, and e-mailed messages also were used to attract participants. There were 210 women who expressed interest and were eligible to participate in this study; of these, only 121 (57.6% of eligible) consented to participate in this study.

An important finding was that women who were successfully recruited into this study perceived the interaction with the researcher as the most effective recruitment method. According to several researchers, active recruitment involves the researcher targeting and asking participants to enroll in a study (Lee et al., 1997; Linnan et al., 2002; Sarkin et al., 1998; Yancey et al., 2001). Passive recruitment methods, such as posters, flyers, and newspaper ads, were also used to recruit participants into this study. Although a majority of the women recruited into this study reported that my presentation was the most effective method of recruitment, I did not track which specific method was responsible for each participant's decision to join the study. Thus, it is not known

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whether active or passive methods of recruitment were more effective, only that the majority of the women recruited into this study reported that an active method of recruitment seemed more successful in persuading them to join the study.

This study had an attrition rate of 7.4% and a retention rate of 92.6%. Several methods were used to increase retention of participants, including (1) e-mail and phone messages to remind participants in the sealed pedometer control group to meet for data collection, (2) e-mail messages to remind participants in the unsealed pedometer control group not to change their activity level and wear pedometer and record the steps, and (3) e-mail messages to Web-CT and personal mailboxes to encourage participants in the intervention group to visit information modules and submit goals and recording sheets. By comparison, Barrett (2000) and Wilbur and colleagues (2001) conducted studies with similar sample sizes and reported retention rates of 69% and 89%, respectively. Several studies using internet-mediated interventions reported retention rates from 35% (Frenn et al., 2003) to 87% (McKay et al., 2001). In a similar study using middle-aged women and an internet-delivered intervention, Whitely (2001) reported a retention rate of 79%. Studies conducted with smaller sample sizes tended to retain their sample. Therefore, considering the larger sample size and research design of this study, the retention rate was excellent when compared to the previous studies.

Most women enrolled in this study to change their health behavior or because it sounded like something interesting to do. Therefore, it can be assumed that they had intentions to change their health behaviors. Gift certificates and free academic credit were suggested as the best inducements to participate in research studies. These incentives were suggested after the pilot study and used in the current study.

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On the basis of these findings, researchers should consider the findings of this study when recruiting a sample. Less than 10% of the women approached for participation were actually enrolled. Active recruitment methods and incentives of gift certificates and free academic credit were perceived as effective in recruiting women to a physical activity intervention study. Particularly in physical activity intervention studies, researchers should discover participants' intentions when enrolling in a study.

Maintenance

Attendance was high at the beginning of the intervention and decreased as it progressed. Leslie and colleagues (2005) suggested that a brief face-to-face contact to introduce the Website to users may encourage participation; however, this study found that although all of the women in the intervention group were offered Web-CT training on the intervention, only three women attended training. These findings suggest that future interventions should require participation in training to introduce the Website.

Leslie and colleagues (2005) stressed that methods are needed to attract and prompt participants to use Websites. Although the women in the physical activity intervention varied as to how often they accessed the intervention on Web-CT, the results of this study were in contrast to other studies that found no increase in physical activity (Marshall, Leslie et al., 2003; McKay et al., 2001; Whitely, 2001). There may have been other barriers for participants' use of the Website, such as technological problems. For example, 5 women (8.3%) gained access to the intervention less than 5 times, 52 women gained access on 21 to 99 occasions, and 17 women gained access on more than 100 occasions. Web-CT also provides information as to whether or not students are reading

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and posting messages on the bulletin board. At least 11 women never read any messages on the bulletin board and 34 women never posted messages. In contrast, 25 women read the bulletin board on 31 to 70 occasions and posted between one to four messages each. Women who read the bulletin board reported that they enjoyed the interaction with me and the suggestions they received from the other participants in the program.

In addition to the bulletin board component of Web-CT, tutorials on lifestyle, physical activity, self-efficacy, and self-monitoring were assigned to the women. Tracking mechanisms on Web-CT allowed me to determine if study participants were viewing these tutorials on physical activity. Only 11 women (18.3%) watched all nine tutorials. More importantly, 10 women (16.7%) never watched any of the tutorials. The tutorials most watched were, "What is Lifestyle Physical Activity?" (61.7%) and "Monitoring Your Progress" (53.3%). These modules may have seemed most important to participants.

The tutorials related to exercise self-efficacy were titled, "Choices and Strategies," "Identifying Barriers," and "Strategies to Overcome Barriers." Less than half of the women watched these tutorials. For example, "Choices and Strategies" was watched by 23 women, and 2 of the women watched it twice. Sixteen women watched "Identifying Barriers," and 1 watched it twice. Last, 16 women watched "Strategies to Overcome Barriers," and 2 watched it twice. Therefore, 38.3% of the women in the intervention group watched the tutorial on "Choices and Strategies," 26.7% watched the "Identifying Barriers" tutorial, and 26.7% watched the tutorial on "Overcoming Barriers." One explanation for the findings of the current study on the mediation of

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physical activity by exercise self-efficacy may be related to low attendance to these tutorials dealing with exercise self-efficacy and how to increase it.

Leslie and colleagues (2005), McKay and colleagues (2001), Sciamanna and colleagues (2002), and Whitely (2001) found that participants in their studies did not use the Web-site to receive the intervention and did not have a significant increase in physical activity. This study's findings suggest that although most (86.7%) of the women gained access to the intervention on the Web-CT, less than half (42%) were communicating with me, and a little less than one-fourth (18.3%) obtained the information from all the tutorials. Moreover, 10 (16.7%) of the women never watched the instructive components of the intervention. Those women who accessed the intervention but not communicating or viewing the tutorials were probably online to submit their goals and weekly steps. However, unlike the previously-mentioned studies, this study found that although participants varied in their use of the Website, they significantly increased their physical activity level. This finding suggests that these women either individualized the Web-based intervention using the parts most valuable to them to meet their goal or were motivated by other reasons to increase their activity. As reported earlier, frequency of using the Website did not make a difference in steps. This finding supports Speck and Looney (2001) who suggested that physical activity level can be influenced by keeping a daily log of steps.

Many of the women stated that they did not have time to gain access to the Website because of other school and work responsibilities. Therefore, findings from this study concur with studies by Sciamanna and colleagues (2002) and Whitely (2001) identifying lack of time as a barrier to using internet-based interventions.

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One explanation for decreased use of Websites in other studies was the perception that intervention material was not helpful or useful (McKay et al., 2001; Sciamanna et al., 2002; Whitely, 2001). Of the women who viewed and evaluated the tutorials, only 3 reported that a tutorial was not useful. One woman felt the tutorial on introducing lifestyle physical activity did not present information to help her increase her physical activity level. The other 2 women did not feel the links in the tutorials on identifying barriers and places to walk were helpful. The suggestion was made to add the information at the links to the tutorial itself. This finding suggests that some women did not have the time or desire to pursue links to other sites on the Web. Above all, the information presented through the tutorials was helpful and useful to the women in the intervention.

Women were motivated to continue participating in the intervention because of the combination of goal setting and self-monitoring and the walking program, itself. Unlike Leslie and colleagues (2005) who argued that interactive sites that required making and submitting goals and logging activity would enhance engagement, this study found that as the weeks progressed submission of goals and pedometer steps decreased. Some women never submitted their steps through the internet. One explanation for this finding may be that women had a recording sheet on which to record their daily steps. It may be that teaching individuals how to make step goals and giving them a device to monitor steps may be enough of an intervention to increase activity. Many women reported they were able to review their walking goal and weekly steps and see the progress they were making. Seeing their progress increased confidence that they could meet their walking goal. The women were aware that they would be meeting with me at

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the end of the study and planned to submit this log at that time. Only 1 woman stated that she continued in the study become of her commitment to remain involved.

Women were deterred at times with continuing participation in the study because of personal preferences and lack of motivation. A few women stated that they did not enjoy exercise of any kind, including walking. Although several authors found that walking was the preferred physical activity of females, it may be that some women prefer not to do any activity (Belza & Warms, 2004; Ransdell, Vener et al., 2004; Wallace, 2003). Women who also had issues with time management were challenged to participate in the program. Again, these findings are consistent with studies by Sciamanna and colleagues (2002) and Whitely (2001) that found lack of time was a barrier to study participants accessing internet-delivered interventions. Given that "lack of time" is given as a reason for inactivity in many studies and that it is unclear as to whether lack of time resulted from a busy lifestyle, perceived lack of time, an easy excuse, or a lack of commitment to exercise, future studies could investigate its meaning and determine its implications for study design.

Based on these findings, it appears that physical activity interventions delivered through Web-based media experience problems in implementation. The intervention for this study explained between 11% to 22% of the variance and exercise self-efficacy explained only 2% of the variance in physical activity behavior. That is, almost 76% of the variance was unexplained. There were no relationships noted between those women who were successful in meeting their goals for 3 or 4 weeks of the intervention and other variables measured in this study. It may be that meeting with me to discuss making step

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goals and using a pedometer to monitor one's activity was enough of an intervention to increase physical activity level.

Participants in Web-mediated interventions have the option whether or not they want to receive the information presented. This study found that the women differed in the components of the physical activity intervention and the amount of time they spent on the Website. To be successful, Web-mediated interventions should present information that is perceived useful to women and provide for alternative forms of record-keeping.

As this discussion has illustrated, a theory-based, Web-CT-mediated physical activity intervention can be successful in increasing the physical activity level in college-aged women. This study has presented additional information about a theory-based and Web-mediated physical activity intervention for college-aged women. It identified strengths and weaknesses of the intervention through process evaluation that can be used to develop interventions that are more effective in the future.

Limitations of Study

In addition to previously mentioned limitations, there were a few additional limitations that should be discussed. First, some attrition occurred whether it was from voluntary drop out, illness, injury, or lack of interest in completing the study. Although the data analysis plan considered attrition and increased the proposed sample size, the targeted sample size was not attainable. Social pressure to receive information for the study's initial meeting may have influenced the women to appear interested, though they did not intend to consent to participate in the study itself. Relying on e-mail messages alone to contact potential participants was a limitation to this study as some women did

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not read their e-mails. The time between recruitment and the start of the study (in some cases, up to 7 months) may also have influenced both consent and attrition rate. Some participants who had consented to the study were frequently notified by phone because they did not read their e-mails.

Second, a questionnaire on physical activity level was used to determine eligibility to enroll in the study. Social desirability bias may have influenced participants to answer in ways to influence their access into the study. Using a pedometer to screen eligible participants may provide a truer picture of the baseline physical activity level of participants.

Third, although an objective measure was used to measure physical activity, the participant was responsible for reporting the data to me. Socially desirability bias may have influenced the participant to record steps inaccurately. The participant also may have forgotten to wear the pedometer or record the steps at the end of the day. All attempts to minimize missing data with e-mail reminders, phone calls, and forms to record steps during the intervention were implemented. Additionally, I checked for missing data and computed necessary imputations before final data analysis.

Fourth, a limitation concerning the pedometers was in obtaining baseline steps. Initial baseline steps may have been higher than usual because the 7-day period for obtaining these steps was over the Labor Day holiday weekend. Thirteen women reported they hiked; worked at the County Fair; visited shopping malls in St. George, UT, or Las Vegas, NV; or attended a school dance. The elevated baseline steps increased their mean steps and may have affected whether or not women in the intervention group were able to meet their goal.

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Fifth, there were eight pedometers lost during the intervention, six clips were broken rendering the pedometer inoperable, and one pedometer required battery replacement. The pedometers and batteries were replaced within 1 hour of notification. Ten safety straps were never returned. An explanation for this loss was that many of the students removed the safety strap from the pedometer because it irritated their skin. However, this practice probably contributed to the loss of several of the pedometers.

Sixth, there were several power failures on the university campus and surrounding neighborhoods that may have affected participant internet access. A power outage during the first Friday of intervention occurred from 3:30 p.m. to 5:30 p.m., and again during the last weekend of the intervention from Saturday morning until Monday morning.

Finally, the mechanism that Web-CT uses for submitting goals and pedometer steps was through the quiz function. A quiz was developed to ask a participant about her weekly goal, the times they wore the pedometer, and the number of steps taken each day. Although, participants were informed that the quiz was not graded and was to be used only as a means for them to submit their data to me, many students panicked the first time they entered the quiz section. Another limitation concerning the Web-CT quiz function was that it was prearranged to allow participants to send one set of goals and steps per week. It was soon apparent that some women wanted to enter several weeks of steps at the same time later in the intervention. This inclination required me to remove the time limitations from these forms. Future studies should consider developing alternative methods of submitting goals and steps. For example, participants could record steps on a printed form or submit steps on Web-based forms that are similar to the printed register.

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Web-based forms would permit more flexibility in allowing participants to submit steps either daily, weekly, or monthly.

Implications for Nursing

Despite the study's limitations, several aspects of the research findings have important implications for nursing practice, research, and education.

Implications for Nursing Practice

The findings provide information about the development and implementation of physical activity interventions that promote walking behavior in young women. Nursing professionals who have access to women in this age group can incorporate the qualitative findings of this research into intervention strategies aimed at increasing physical activity. Examples might include developing college-aged women's skills in time management and increasing their skills in overcoming barriers to physical activity. The use of pedometers as a means to monitor physical activity behavior can be used as an adjunct to goal setting to motivate women to change their health behavior.

Implications for Nursing Research

Results from this study complement the growing body of knowledge supporting theory-based interventions to promote physical activity. Future interventions that promote lifestyle physical activity could benefit from revising the Exercise Self-Efficacy Scale to provide a more reliable measure. Replacing the word "exercise" with "walking" may render the scale less emotional to respondents who do not like to exercise. Reliability tests should be conducted on the revised scale.

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Moreover, findings on recruitment information, context, and maintenance provided some insight into factors that are associated with walking in college-aged women. One suggestion for future physical activity intervention studies is to screen participants for eligibility using objective measures, such as a pedometer. This will assist the researcher in identifying and enrolling persons with low physical activity levels. Another suggestion is to increase opportunities for social activities and peer support in this population. Last, continued research is needed to identify more effective ways to encourage women to motivate logging on to internet-delivered interventions

Since research on mechanisms of change is relatively scarce, other constructs associated within the Social Cognitive Theory should be tested to determine if mediation occurs. Especially important to women are the constructs of self-regulation, body image, and social support. Instruments for self-regulation should be developed that measure this construct for use in future research on physical activity interventions.

Implications for Nursing Education

The findings from this study have implications for nursing education. In preparing future nurses for a role in health promotion, nursing students need information on physical activity and behavior change within individuals. They should be assigned classroom activities that include changing their behavior which would increase the student's ability to plan health behavior changes for clients in a more realistic manner. Therefore, to offer better quality care in the future, nursing students must be taught about models of behavior and their application as to how they change behavior.

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Recommendations

Recommendations for Future Research

One suggestion for future physical activity intervention studies is to repeat this study using a pedometer with a timer. This instrument would capture data on intensity and frequency aspects of physical activity behavior.

Within the school environment, future studies also could combine classroom sessions with Web-CT. Topics for classroom sessions could include time management skills, barrier identification, and ways to overcome barriers. Classroom time could be used to increase social support among participants and ease the burden of data collection. Additionally, groups could be clustered by academic school. This grouping could increase camaraderie and foster social support and team spirit. Secondary competitions between schools could be used as a way to motivate participation and encourage physical activity. Incentives should be tied to completion of classroom assignments and submission of goals and recording sheets.

Another useful study would include two intervention groups, one that required the participant to use Web-CT at predetermined times and one that allowed the participant to use Web-CT at their discretion. The purpose of this study would be to determine if participation improves when students have designated times in which they are required to access Web-CT.

Process evaluations should be part of all interventions and should include a cost-benefit analysis of the intervention to determine the cost of maintaining involvement of the participants in the intervention, including researcher's time and the cost of incentives. For example, labor intensiveness of physical activity interventions could be reduced by

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collaborating with other researchers to reduce the burden of data collection and using graduate students to "adopt" groups of participants to maintain e-mail and phone contact.

Conclusions

This is the first study conducted to examine whether a theory-based, Web-CT-mediated intervention can increase physical activity in college-aged women. Rather than rely on self-report methods to measure physical activity, this study used an objective measure, the pedometer. This study included a process evaluation to determine strengths and weaknesses of the intervention and possible mediation of the intervention by self-efficacy.

Results suggest that a theory-based, Web-CT-mediated, physical activity intervention is successful in increasing the physical activity level in college-aged women. Furthermore, it appears that pedometers, used in conjunction with goal setting, can increase women's physical activity level.

The results provided evidence for the partial mediating effect of self-efficacy between physical activity intervention and physical activity. However, further studies on mediators of health behavior change are needed. Results also suggest that important factors contributing to some of the women not walking were the weather, safety concerns, fatigue, and health. In addition, women reported a lack of motivation and time to walk. The results provide evidence that physical activity interventions delivered through Web-based media experience problems in implementation. Results also suggest that participants of internet-delivered physical activity interventions have the option of determining how much time they spend using the intervention.

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This study reveals that, although physical activity interventions can increase physical activity behavior in college-aged women, recruitment, contextual, and maintenance factors may play a critical role in physical activity behavior and need to be considered in developing physical activity interventions for this population. The results of this study cannot be generalized to college-aged women from other colleges and universities but rather only to the college-aged women being examined in this study.

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APPENDIX A

REVIEW OF PREVIOUS STUDIES

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Table 35. Summary of Physical Activity Intervention and Process Evaluation Studies

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Barrett, 2000	Middle-aged women USA N = 165 114 completed retention rate=69% Mean age = 47 yrs 92% white 67% married 73% college educated	↑ PA level RCT - 2 groups: experimental (n = 81), comparison (n = 84)	W, SR, HPM	Intervention = 8 weeks Internet-mediated Experimental Group: Stage-matched to SOC email messages sent weekly Comparison Group: Emails with standard exercise information from AHA sent to sent weekly.	No differences in energy expenditure between intervention and comparison group. Most frequent activities were: housekeeping, walking, stair climbing, and gardening.	No control group; comparison group used. No objective measure of PA
Blissmer et al., 2002	Adults USA N = 288 183 completed retention rate = 63% Mean age = 43 yrs 74% female 71.5% college educated 90% white 68% married	↑ PA level Experimental - 4 groups: stage-matched (n=72) stage-mismatched (n=72) action message (n=72) and control (n=72)	SR, TTM	Intervention = 16 weeks Stage-matched group received information related to SOC Stage-mis-matched group received information for stage other than they were inAction message group received message unrelated to TTM theory Control group received general health information sent monthly.	Both stage-matched and action message groups ↑ their PA. Both stage-mismatched and control groups ↓ their PA.	No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Brassington et al., 2002	Older Adults USA N = 103 Mean age = 70 yrs 65% = female 95% = white	Mediators of PA RCT – 3 groups: Moderately-intense Stretching/flexibility Telephone-counseling	SR, PE: Mediation: SE, OE (DA method - Kraemer et al., 2001, 2002)	Three conditions of intervention included: Exercise prescription 1. Moderately-intense 2. Stretching/flexibility Telephone counseling	I → B: Yes I → M: Yes (SE r^2 = .14; OE r^2 = .05) M → B: Yes (SE r^2 = .21; OE = NS)	No control group. No objective measure of PA. Sample white, well-educated, healthy
Cardinal et al., 2002	College Students USA N = 540 Mean age = 20 yrs	↑ PA level QE – 3 groups: class (N=394) prior class (N=96) no class (N=50)	SR	Intervention = 10 weeks Class consisted of general fitness information on PA, stress, diet, & chronic disease.	No differences between groups in PA.	Unequal group sizes. Not theory-based. No objective measure of PA
Cox et al., 2002	Older women UK N = 126 90 completed retention rate =71% Age range = 40-65	↑ PA level RCT – 4 groups: Structured Moderate (n=31) Vigorous (n=33) Home-based Moderate (n=32) Vigorous (n=32)	SR	Intervention = 18 months Structured group had fitness center privileges and attended 3 x week for physical activity. Home-based group attended 10 sessions at a fitness center and then performed exercises at home.	No difference between groups in energy expenditure at 18 months.	Not theory-based. No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Crouteau, 2004	Adults USA N = 37 37 completed retention rate=100% 78% female 100% white Mean age = 44 yrs	↑ PA level Nonexperimental: 1 group pretest-posttest design	W, P (Yamax SW-200), SR	Intervention = 8 wks Counseling covered goal setting, strategy selection, pedometer use, self-monitoring, & follow-up. Emails were sent to remind about data collection, provide tips.	Paired t-tests: Significant ↑ in mean steps/day for the group as a whole. Greatest increases were in those who avg. <6000 steps at baseline and who were obese.	Small, homogenous sample. Non-exp. design. Not theory-based. Calibration procedure for pedometer not given
Dallow et al., 2003	Women USA N = 58 44 completed retention rate = 76% Mean age = 46 yrs	↑ PA level Experimental - 2 groups: intervention (n=29) and control (n=29)	SR, TTM	Intervention = 24 weeks Intervention was a lifestyle PA group that met weekly for 8 weeks for 90 minutes to discuss PA. Then, group met monthly to 16 weeks.	Significant ↑ in energy expenditure between intervention and control group	No objective measure of PA
Dunn et al., 1999	Adults USA N = 235 190 completed retention rate = 80% 50% female Mean age = 46 yrs	↑ PA level RCT – 2 groups: Structured (n=114) Lifestyle PA (n=121)	SR, SCT	Intervention = 6 months. 18 month follow-up Structured group worked out 5 days/week for 6 months at fitness center Lifestyle PA group asked to ↑ physical activity 30 minutes / day	Both groups ↑ PA	No control group; comparison group used.

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Elbel et al., 2003	Male adults USA N = 148 Mean age = 43 yrs	↑ PA level Pre-test/Post-test QE – 3 groups: pro-led (n=71) peer-led (n=49) control (n=28)	SR, SCT, PE: Mediation: SE DA Method: ANOVA for I → B	Intervention consisted of classes about physical activity lead by professional (pro-led), peer (peer-led), or did not attend class (control)	Peer led group ↑ in PA but not significantly I → B: No change I → M: No change M → B: Not Done	Work-related events confounded results. Unequal group sizes. No objective measure of PA No regression done for mediation.
Frenn et al., 2003	Middle school students USA N = 341 120 completed retention rate=35% Age range = 12 - 15	↑ PA level QE intervention (n=67) control (n=63)	SR, HPM / TTM	Intervention length = not given 4 internet and video sessions of approx. 50 minutes with info about physical activity Control received no treatment	PA ↓ in both groups.	High attrition rate. No objective measure of PA
Garcia & King, 1991	Adults USA N = 74 43% = female Mean age = 56 yrs	↑ PA level RCT – 4 groups: Moderate-intensity structured, Moderate-intensity home, Low-intensity home, Control	SR, SCT, Mediation: SE (DA method: Multiple Regression)	Randomly assigned to three exercise conditions or control.	I → B: Yes I → M: No M → B: Yes, $r^2 = .17$	Small sample for 4 treatment conditions No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Hager et al., 2002	Adults USA N = 525 402 completed retention rate =77% Mean age = 42 yrs 56% female, 94% white, college educated	↑ PA level RCT - 3 groups: Stage-matched (n=175) Action (n=175) Control (n=175)	SR, TTM	Intervention = 5 weeks Internet-mediated Weekly email messages sent based on SOC: (stage-matched), one-size-fits-all active (action), or general health (control).	Stage and Action groups ↑ leisure activity level. Action group ↑ energy expenditure and occupational activity.	No objective measure of PA
Hallam & Petosa, 1998 Hallam & Petosa, 2004	Adults USA N = 125 68 completed retention rate = 54% 53% = female Mean age = 37 yrs.	Non-equivalent, pretest-posttest, comparison group	SCT PA not measured PE: Mediation: SE, OE (DA method: ANOVA for I → B; Regression analysis for I → M and M → B)	Intervention = 4 1-hour sessions - first session: frequency, intensity and duration of PA needed; goal-setting - second session: expected outcomes of exercise, time management, exercise plan, goals - third session: social support, reinforcement, preventing relapse, revising goals - fourth session: functions of warm-up, stretching, and cool-down, proper equipment, goals.	Did not measure PA level I → B: Yes I → M: SE (Yes); OE (Yes) M → B: SE (No); OE (No)	No control group; comparison group used Nonrandom assignment to groups Significant number of less sedentary participants in each group

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Kirk et al., 2001	Adults with Type II diabetes UK N = 26 23 completed retention rate =88% Mean age = 49 yrs	↑ PA level and quality of life RCT - 2 groups: Intervention (n = 12) comparison (n = 13)	W, A (CSA), SR, TTM	Intervention = 4 weeks Both intervention and comparison groups received educational pamphlet. Intervention group had 30 minute consultation (not stage-matched) on starting exercise program.	Significant ↑ in walking minutes between intervention and control group. NS quality of life changes.	Small sample No control group; comparison group used.
Kirk et al., 2003	Adults with Type II diabetes UK N = 70 63 completed (retention rate =90%) 50% female Mean age = 58 yrs	↑ PA level and glycemic control RCT - 2 groups: intervention (n = 35) comparison (n = 35)	W, A (CSA), SR, TTM	Intervention = 6 months Both intervention and comparison groups received educational pamphlet. Intervention group had 30 minute consultation (stage-matched) on starting exercise program.	Significant ↑ in walking minutes between intervention and control group. Significantly more control of glycemic mechanisms in experimental group	No control group; comparison group used

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Lee & Cubbin, 2002	Youth USA N = 8,165 51% = female 68.4% = white Mean age = 16 yrs	Determine context of physical activity.	PE: Context: Neighborhood factors (family income, poverty & education level, % blue collar) Individual factors (gender, SES)	No Intervention Structured interviews, census info	Neighborhood not associated with PA ↓ SES associated with ↓ PA	No objective method of PA Data collected in different years (Neighbor-hood factors – 1990; Physical activity level - 1992)
Lee et al., 1997	Women USA N = 126 Mean age = 38 yrs	Recruitment into studies.	Recruitment: Active: Targeted Telephone Face-to-Face contact Direct mailings Passive: Social networking & announcements at meetings Flyers News Ads Maintenance	Determine if there is a difference in two methods of recruitment	Recruitment: Efficiency rate: Passive method – 64% Active method – 11% Most effective methods: Flyers – 78% News Ads – 60% Maintenance: Attrition: Passive method – 24% Active method – 16%	Ambiguous definition of 'active' and 'passive' Inaccuracy of phone and address lists Unable to know exact number of potential participants saw ads, flyers. Small sample size. Reasons for attrition not given.

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Leslie et al., 2005	Adults Australia N = 327 Mean age = 43 yrs Mean BSA = 24 kg/m^2 Works full-time =81%	Process evaluation of study done by Marshall et al., 2003b	PE: Maintenance / Program Implementation	Evaluated use of internet by participants.	46% visited site at least once Most of these (46%) were in Action or Maintenance stage Least of these (16%) were in pre-contemplation stage Average time in site = 9 minutes Average pages visited = 18 Home page visited most frequently 91% participants said they read first email 23% participants said they read all 4 emails	

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Linnan et al., 2002	Adults USA N = 1906 92.5% = white Mean age = 42 yrs	Investigation of different components of process evaluation.	PE: Reach Recruitment Active: No info provided to target group Participant contacted researcher Passive: List of phone numbers given researchers Telephone Maintenance	No intervention. Different worksites used to test two methods of recruiting into a study. Both groups exposed to meeting explaining study, flyers, incentives, & posters.	Reach: Active method: 24.4% Passive method: 74.5% Recruitment: Efficiency rate: Passive method – 40.9% Active method – 77.5% Maintenance: Attrition: Passive method – 46% Active method – 29.9%	Ambiguous definition of 'active' and 'passive' No objective measure of PA Failed to control for confounding variables in different worksites Non random assignment of worksite to group

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Lombard et al., 1995	Adults USA N = 135 retention rate=not given 98% female Mean age = 40 yrs	↑ PA level and determine effects of prompting and self-monitoring on walking behavior 2 x 2 repeated measures Groups: Frequent feedback & goal setting (n=27) Frequent touching base (n=27) Infrequent feedback and goal setting (n=27) Infrequent touching base (n=27) control group (n=27)	W, SR	Intervention = 6 months 15-minute training session (how to fill out logs, how to start a walking group) Prompting could be *frequent or infrequent,* Feedback could be *specific or infrequent,* goal-setting Touching base could be *frequent or infrequent*	More frequent prompts of high intensity (once every week) are more effective in adherence to walking program.	Small number in each group. Not theory-based No objective measure of PA
Loughlan & Mutrie, 1997	Adults UK N = 179 74% female Mean age = 37 yrs	Randomized design, Three groups: Fitness assessment (n =75) Exercise consultation (n=61) and Information only (n=43)	SR	Intervention = 12 weeks - fitness assessment group received normal cardiopulmonary fitness assessment. - exercise consultation group received 30 minutes of information specific to exercise, barriers, benefits	All groups significantly ↑ their PA level.	No control group; comparison group used. Not theory based No objective measure of PA

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
				- information only group received booklet.		
Marcus et al., 1998 Bock et al., 2001	Adults USA N = 194 150 completed retention rate= 77% 76% females 58% married Mean age = 44 yrs	Experimental 2 groups Individualized tailored (N= 78) Standard Care (N=72)	SR, TTM	Intervention = 6 months Tailored messages according to SOC given to IT group and information leaflet given to SC group. Follow-up to intervention =12 months	Significant ↑ in PA level between intervention and comparison group Significant ↑ in PA level between intervention and comparison group	No control group; comparison group used No objective measure of PA
Marshall et al., 2003b	Adult Australia N = 655 512 completed retention rate = Mean age = 43 yrs	RCT Two groups: Print (n=328) Internet (n=327)	SR, TTM	Intervention = 8 weeks Internet-mediated vs Print Print group received booklets stage-matched to their stage on exercise and PA Internet group logged onto website which contained same content (could access as wanted). Received reinforcing emails every 2 weeks.	No difference between groups.	No objective measure of PA

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Marshall et al., 2003a	Adults Australia N = 462 retention rate = 77% Mean age = 49 yrs	RCT Intervention (n=227) Control (n=235).	W, SR, TTM	Intervention = 8 weeks Intervention group: received Booklets according to their SOC Control group: no treatment	Significant ↑ in walking minutes between intervention and control group at 8 weeks.	No objective measure in PA
Maxwell et al., 2002	Filipino Women USA N = 530 487 completed retention rate = 92% Mmean age = 63 yrs	Experimental Two groups: Exercise instruction (n=248) Cancer screening (n=235)	SR	Intervention = 3 months One training session given to exercise instruction group on health benefits, warm-up and stretching exercises, examples of lifestyle physical activities. Cancer screening group got no information on PA	Attending exercise instruction ↑ PA of cancer screening group.	Not theory-based. No objective measure in PA

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
McKay et al., 2001	Adult people with Type II diabetes Australia N = 78 68 completed retention rate =87% 53% female Mean age = 52 yrs	↑ PA level RCT – 2 groups: Experimental (n = 38) comparison (n = 40)	W, SR, PE: Program Implementation Dose Received	Intervention = 8 weeks Internet-mediated Program of self-management based on 5 action steps. Counselor available by phone	No difference in PA level. Program Implementation: Usage of program declined over the 8 weeks. Dose Received: Greater overall satisfaction among intervention participants 88% found the personal coach component helpful, 35% found peer-to-peer support helpful	No objective measure of PA Small sample Not theory-based
Mutrie et al., 2002	Adults UK N = 295 retention rate = 66% 64% female Mean age = 38 yrs	↑ PA level RCT intervention (n=145) or control (n=150)	W, SR, TTM	Intervention = 12 months Packet of information about benefits, starting, maps given to intervention group. Control group received no information.	Significant ↑ in walking minutes between intervention and control group	No objective measure of PA

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Napolitano et al., 2003 Sciamanna et al., 2002	Adults USA N = 65 retention rate = 80% 63% married 91% white Mean age = 43 yrs	↑ PA level RCT - 2 groups intervention (n=30) control (n=35)	W, SR, TTM/ SCT, PE: Program Implementation – Perception of Barriers Dose Received	Intervention = 3 months Internet website in which intervention group received information. Weekly emails sent to participants to access website	Significant ↑ in walking minutes between intervention and control group Perception of Barriers: Main barrier: Lack of time (62.5%) Didn't think info was useful (8.3%) Dose Received: Helpful (79.2%-somewhat; 12.5%-very) Use (more than once by 83.3%) Frequency of use of each component of intervention varied with SOC.	No objective measure of PA Relied on emails sent to worksite to prompt website use No direct tracking of website use (self report) Small sample size Sample from one hospital with internet access

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Naylor et al., 1999	Adults UK N = 294 180 completed retention rate=61% 77% female Mean age = 42 yrs	RCT - 4 groups: 1. stage-matched with counseling (n=178) 2. stage-matched without counseling (n=39) 3. non-staged with counseling (n=36) 4. counseling only (n=41)	SR, TTM	Intervention = 24 weeks Groups received 30 – minute exercise counseling or just exercise pamphlet, either staged or non-staged: - Staged information meant it was appropriate to their SOC. - Non-staged information meant it was general information about exercise. Counseling only group served as control: asked not to change current practice.	No difference between groups in PA level.	Unequal group sizes. No objective measure of PA

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Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Nies et al., 2003	Middle-aged women USA N=197 159 completed retention rate=81% 52% white 48% married Mean age = 44 yrs	↑ PA level and health enhancing benefits RCT - 3 groups intervention (n=67) attention control (n=60) control (n=70) Groups further split into North and South	W, SR	Intervention = 24 weeks Both groups encouraged to walk 90 minutes / week at orientation. Intervention group telephoned weekly for 8 weeks, every other week for 16 weeks. Given advice on walking, goal setting, etc. Attention-control group received same number of calls but only asked how much walking they did. Control group was not called.	↑ walking in intervention group. Southern women walked more than northern women.	Not theory-based No objective measure of PA
Oja et al., 1998	Adults Finland N = 71 68 completed retention rate=78-92% Adults Finland N = 1256 Retention rate=57%	Health-enhancing benefits RCT – 2 groups: Physically active (n=35) and Passive commuting (n=33) Pre-experimental	W, SR , physiological: (blood lipids, treadmill time, VO2 max)	Intervention = 6 months Information through bulletins, leaflets, and company newsletters mailed to employees. Activity diaries, lottery incentives and fitness testing used to motivate. Commuting maps for walking/biking were distributed.	No change in lipids. ↑ in treadmill time and VO_2 Max in intervention group. 27% ↑ commuting physical activity, 19% ↑ leisure-time activity.	Not theory-based No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Pate et al., 2003	5th graders USA N = 558 436 completed retention rate = 78%	QE design within communities: intervention (n=175) comparison (n=261)	SR, SCT /HPM, PE: Implementation Intervention Fidelity	Intervention length = 18 months. Data collection in spring. Intervention components: (1) *after school pa program* (2) *summer pa program* (3) *home* - newsletters and take-home activities, and (4) *community* – news articles in paper, local TV	No difference between groups in PA level. Implementation: Home and community aspects not strongly implemented. Intervention-providers did not understand program Target audience did not receive sufficient exposure to intervention (only 5% attended at least ½ of total sessions), Intervention fidelity Program matched theoretical basis Additional findings - Context: Competitive small community rivalries - social barriers and discipline problems interfered with intervention	Attendance to intervention low among participants. No objective measure of PA Instruments used to measure variables had low reliability

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Pinto et al., 2002	Adults USA N = 298 72% female 45% white Mean age=45 yrs	RCT – 2 groups: intervention (n=150) control (n=148)	SR, TTM/ SCT	Intervention = 3 months Intervention group received computerized exercise advice by telephone. Computer asked questions based on respondents' answers.	At 3 months, 27% of intervention group compared to 18% of control group ↑ their PA level.	No objective measure of PA
Powers-Noland, 1989	Adults USA N = 77 69 completed retention rate=90% Age range = 34 - 38	↑ PA level & determine effects of self-monitoring and reinforcement on walking behavior. Randomized block – 3 groups: Self-monitoring (n=27) Reinforcement (n=26) Control (n=25)	W, SR	Intervention = 18 weeks Each participant met with investigator for 10 minutes. Instructions given to exercise with at least one other person, use pulse rate, emphasized walking, jogging, and swimming.	Self monitoring and reinforcement groups had ↑ levels of PA as compared with control group.	Small sample Not theory-based No objective measure of PA
Prodaniuk et al., 2004	Adults Canada N = 897 74% = female Mean age = 42 yrs	Mediators of PA	SR, PE: Mediation: SE, OE (DA method: Baron & Kenny (1986)	No intervention	I → B: No intervention done I → M: No intervention done M → B: SE (yes, 13% of variance explained) OE (no)	No intervention done. Not theory-based No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Ransdell et al., 2001	26 mothers and daughters USA	QE, pre-test, post-test	SR, SCT	Intervention = 12 weeks Intervention components: 1. Mother-daughter groups came to campus twice a week for 12 weeks. Educational topics given at sessions focusing on recreational physical activity. 2. Asked to increase pa outside of class and to participate in additional exercise sessions 1-2 days per week. 3. Individuals were asked to talk about their activity and how to promote more ways to be active.	No change inPA	Small sample No objective measure of PA
Ransdell et al., 2002, 2003	Mothers and daughters USA N=40 34 Completed retention rate = 85%	Randomized pretest/posttest Two groups: Center-based (n=20) Home-based (n=14)	SR, SCT, PE: Intervention Fidelity	Intervention = 12 weeks Pilot (UT) Home-based group received packet of info of lifestyle physical activities Center-based group met 3 x week to participate in physical activities	Both groups ↑ PA. Grounded in theory and previously-identified characteristics of successful pa interventions. Use of focus group increased participant buy-in	Small sample No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Ransdell et al., 2004	Grandmothers, mothers, & daughters N = 37 86% white	Randomly assigned, pretest/posttest Two Groups: Experimental (N=28) Control (N=9)	P (Yamax SW701), SR, SCT	Intervention = 6 month Constructs of SCT used to ↑ lifestyle, aerobic, muscular strength, and flexibility activities in intervention group. Control group asked to continue usual activities.	Significant ↑ in pedometer steps between intervention and control groups	Small, homogenous sample High attrition in control group Pilot study
Reger et al., 2002	Adults, 50-65 y/o USA N = 1,472 1,088 completed Retention rate = 74%	↑ PA level RCT - 2 groups intervention (n=719) control (n=753)	W, SR, TPB/ TTM	Intervention = 8 weeks Intervention community saw paid advertisements; public relations activities; programs in worksite, churches, and civic groups, physician-initiated prescriptions for walking, and a web site to promote walking. Control community received no information.	Significantly more walking in intervention groups than control group.	Sample did not represent community.
Rovniak et al. 2002	College students USA N = 353 283 completed Retention rate = 80% Mean age = 20 69% = female 83% = white Mean BMI = 23	Mediators of PA Prospective design	SR, SCT, PE: Mediation: SE, OE (SEM)	No intervention done	I → B: No intervention I → M: No intervention M → B: Yes (SE β = .57, p < .05, mediated through SR) No (OE not a mediator)	Non-intervention study OE defined differently

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Sallis et al, 1999 Calfas et al., 2000	College students USA N = 338 321completed retention rate = 95% Mean age = 24 55% = Female	RCT Intervention (n=170) Control (n=168)	SR, SCT PE: Mediation SE (DA Method: ANCOVA for I → B, Regression analysis for I → M and M → B)	Intervention = 15 weeks Intervention components: --Lecture course - GRAD academic course was a one-semester, 2-credit course that met for 50 minutes once/wk. General information about health benefits and physical activity, recommendations for physical activity, and *principles* of behavioral management was given. --Lab – 110 minute lab led by "peer health facilitators". Follow-up to intervention = 18 months Included monthly phone calls and mailings aimed at increasing PA.	No changes in pa between groups or gender. Only women already in Action stage ↑ their energy exp. No significant findings on PA level I → B: No Change I → M: No Change M → B: Not Done	Same intervention for males and females No objective measure of PA. Self selection bias

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Sarkin et al., 1998	College students USA N = 339 Mean age = 24 yrs. 55% = female 57% = white	Effective Recruitment methods	Recruitment (Active: Direct Mailings Telephoning those who responded to mailing) (Passive: List of Student addresses Direct mailings) Maintenance	Two methods used to recruit to PA study	Recruitment: Efficiency rate: Passive method – 37% Active method – 10% Maintenance: Attrition: Passive method – 25% Active method – 53%	Change in procedures between cohort 1 and cohort 2 may have influenced results. Not a controlled study.
Saunders et al., 2003	Older adults USA N = 1,277 69.6% = female 77% = white 47% = married Mean age = 76 yrs	Effective recruitment methods	Recruitment	Collaboration with key groups to recruit to study	Able to recruit a more representative sample. Able to recruit participants from formerly unrepresented ethnic minority group.	Not a controlled study.
Sidman et al., 2004	College-aged Women USA N = 124 Sample not described.	↑ PA level Experimental – 2 groups: TSG: (n=45) PSG: (n=47)	P (Yamax SW 200)	Intervention = 3 weeks TSG: asked to walk 10,000 steps on as many days as possible during intervention. PSG: asked to select a goal of 1,000 to 3,000 steps/day over mean baseline steps/day	Ability to attain TSG was based on baseline mean steps/day – low baseline steps/day did not meet goal as often.	Not theory-based No control group

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Speck et al., 2001	Adult Females USA N = 49 Mean age = 39 86% white, 82% married, 69% college graduate	↑ PA level Longitudinal, pre-test/post-test, experimental, cluster randomization - 2 groups: Intervention (n=24) Control (n=25)	W, P (Yamax SW701), SR, Model for Maintenance of Regular PA in Women	Intervention = 12 weeks Intervention group instructed how to keep records of coded activities on calendar. Both Control and Intervention group wore pedometer	Significant ↑ in walking minutes and mean steps/day between intervention and control group	Small, homogenous sample Calibration procedure of pedometers not given
Swartz et al., 2001	Adult females USA N = 18 18 completed. retention rate=100%	Health enhancing benefits Repeated Measures – 1 group, control then intervention.	W, P (Yamax SW 200)	Intervention = 8 weeks Control period performed first. Participants averaged 4,000 steps/day. Intervention encouraged walking 10,000 steps/day.	Walking (steps/day) improved glucose tolerance, ↓ SBP and DBP. Additionally, pedometers were easy to understand resulting in 85% ↑ in daily ambulatory PA.	Small sample Not theory-based
Talbot et al., 2003	Adults with chronic arthritis knee pain USA N = 34 76.5% = Female, 47.1% = Married, 88.3% = White	↑ PA level RCT two by three design: - 2 groups: Intervention (n=17) Comparison (n=17)	W, A (Tritac R3D), P (Yamax SW-200), SR	Intervention = 12 weeks Intervention group taught how to use pedometers, make goal 30% > baseline. Written activity logs & step counts averaged every week and compared to goal. Comparison group received information on arthritis self-care.	Significant ↑ in mean steps/day walked between intervention and comparison groups.	Small sample Not theory-based

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Titze et al., 2001	Adults Switzerland N=379 35% female Mean age = 41 yrs	QE Intervention (n= 211) Control (n= 168)	SR	Intervention = 4 months Intervention "offices" were supportive of PA: classes, "action days", walking/gymnastic breaks, newsletters about PA	Significant ↑ in PA in intervention group.	Not theory-based No objective measure of PA
Whitely, 2001	Middle aged women USA N = 53 42 completed study Retention rate = 79% 85.7% white 59.5% married 71.5% college educated	↑ PA level Randomized pre-test/ post-test design 2 groups: SCT Education Only Sample size within groups not given.	W, SR, SCT, PE: Program Implementation (including exposure and perception of barriers) Dose Received Mediation: SE, OE	Intervention = 8 weeks Internet-mediated SCT Condition email messages of encouragement, general tips, and information focusing on goal-setting, self-monitoring, problem-solving, and barrier identification, and positive thinking. Education Only email messages of encouragement, general tips, and information focusing on access to *Footprints* Web Site. Also, suggested they walk at least 3 times a week for 20 minutes and self-monitor.	No difference in the times walked or number minutes walked/week between groups. Program Implementation – Exposure SCT group accessed website significantly > Education Only group. Program Implementation – Barriers: too many other time commitments (i.e., home, visitors), personal problems, sickness or injury, tired, stressed.	Small sample No objective measure of PA

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Whitley, 2001, continued:					Dose Received significantly greater satisfaction in SCT group, especially: amount of contact with program director, amount of guidance provided, more helpful to them in becoming active Mediation: I → B: No change I → M: No change M → B: Not Done	
Wilbur et al., 2001	Adult women USA N = 156 139 completed retention rate = 89% 67% white, 54% married, 64% professionals	↑ PA level and adherence Nonexperimental one group, pretest/post-test	W, SR, HRM (Polar), Model of Client Health Behavior	Intervention = 24 weeks Progression of Home-based and moderately intense walking according to ACSM guidelines. Walking increased in duration and intensity to maintain HR at 50-74% of Maximum HR.	Good adherence to intensity and duration (>90%) but less to frequency (66%) 77% of the women who started the program were still walking 6 months later.	Loss of data from battery failure in HRM. Non-experimental design

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Wilde et al., 2001	Adult women USA N = 32 32 completed Age Range = 30 - 52	↑ PA level Non-experimental	W, P (Yamax SW 200), A (CSA), SR	Intervention = 4 days: - two planned walking days to meet 10,000 step goal and - two planned nonwalking days to do normal routine	Days designated as walking had close to 10,000 steps. Non-walking days did not meet goal.	Only 4 day intervention Non-experimental Design Not theory-based. Calibration procedure of pedometers not given.
Woods et al., 2002	College students UK N = 459 223 completed retention rate=50% 62% female Mean age = 19 yrs	RCT - 2 groups pretest/posttest intervention (n=229) control (n=230)	SR, TTM	Intervention = 2 years Mailing of two packages (November, January) of information related to TTM but not stage-matched	Significantly more students in intervention group than control group enrolled in college fitness facility.	No objective measure of PA Did not report PA level

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Table 35 Continued

Study	Sample	Purpose & Design	Study Characteristics	Description of Intervention	Findings	Limitations
Yancey et al., 2001	Women USA N = 854 100% = African-American	Effective recruitment methods	Recruitment Active: Targeted Face-to-Face Telephone Direct Mailings Passive: Targeted mass media (News Ads, Radio) and social networking Flyers	Two methods used to recruit to a study	Efficiency rate: Passive method – 46.5% Active method – 31.9% Heavier women more likely to be recruited through social networking.	

RCT = Randomized control design; QE = Quasi-experimental; SCT: Social Cognitive Theory; TTM: Transtheoretical Model; HPM: Health Promotion Model; P: pedometer; A: accelerometer; HRM: heart rate monitor; SR: self-report; PA: physical activity; ↑: increased; ↓: decreased; TSG: 10,000 step goal; PSG: personal step goal; DA: data analysis; SE: self efficacy; OE: outcome expectations; SR: self regulation; SEM: structural equation modeling; I → B: Intervention was successful in changing behavior; I → M: Intervention was successful in increasing mediating variable score; M → B: Mediating variable was successful in changing behavior.

APPENDIX B

INSTRUMENTS

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Exercise Self-efficacy Scale

Participant I.D. _____

Directions: Using the scale below as a yardstick, please check the answer that best describes how confident you are that you could do the following:

I could exercise:	I cannot do it at all			Moderately certain that I can do it						Certain that I can do it	
1. when tired.	0	1	2	3	4	5	6	7	8	9	10
2. during or following a personal crisis.	0	1	2	3	4	5	6	7	8	9	10
3. when feeling depressed.	0	1	2	3	4	5	6	7	8	9	10
4. when feeling anxious.	0	1	2	3	4	5	6	7	8	9	10
5. during bad weather.	0	1	2	3	4	5	6	7	8	9	10
6. when slightly sore from last time I exercised.	0	1	2	3	4	5	6	7	8	9	10
7. when on vacation.	0	1	2	3	4	5	6	7	8	9	10
8. when there are competing interests (like my favorite TV show).	0	1	2	3	4	5	6	7	8	9	10
9. when I have a lot of work to do.	0	1	2	3	4	5	6	7	8	9	10
10. when I haven't reached my exercise goal.	0	1	2	3	4	5	6	7	8	9	10
11. when I don't receive support from my family or friends.	0	1	2	3	4	5	6	7	8	9	10
12. when I have not exercised for a prolonged period of time.	0	1	2	3	4	5	6	7	8	9	10

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I could exercise:	I cannot do it at all			Moderately certain that I can do it				Certain that I can do it			
13. when I have no one to exercise with.	0	1	2	3	4	5	6	7	8	9	10
14. when my schedule is hectic.	0	1	2	3	4	5	6	7	8	9	10
15. when my exercise workout is not enjoyable.	0	1	2	3	4	5	6	7	8	9	10

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Screening Questions

Physical Activity

Lifestyle Physical Activity is the "daily accumulation of at least 30 minutes of self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life" (Dunn, Andersen, & Jakicic, 1998, p. 399).

Please answer the questions below regarding your current level of physical activity.

1. How many days of the week are you usually physically active for at least 30 minutes? (Include daily walking if you walk at least 30 minutes of continuous or in 3 10-minute bouts of *brisk* walking)
   _____ days

2. Do you participate in any organized sports or physically active recreation (i.e., tennis, biking, etc.) where you are exercising at a moderate intensity for at least 5 days each week?
   a. Yes _____
   b. No _____

3. Are you a member of a gym?
   a. Yes _____
   b. No _____

4. If so, how often do you go to the gym?
   a. Never _____
   b. 1-2 days a week
   c. 3-4 days a week
   d. 5-6 days a week
   e. Every day_____

5. How long do you work out at the gym each day?
   a. 30 min
   b. 1 hour
   c. 1.5 hours
   d. 2 hours or more

6. Describe what do you do at the gym?

   _____

   _____

   _____

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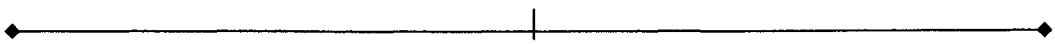
Please answer the questions below regarding your confidence in using the computer.

7. How often do you use a computer?

   a. ___ Daily
   b. ___ Weekly
   c. ___ Monthly
   d. ___ Rarely
   e. ___ Never

8. How often do you use e-mail?
   a. ___ Daily
   b. ___ Weekly
   c. ___ Monthly
   d. ___ Rarely
   e. ___ Never

9. How confident do you feel using a computer? (mark on line)



(0%) Not very confident→ (50%) Somewhat confident→ (100 %) Very confident

10. Have you ever used Web-CT (check one)
    [ ] Never [ ] Used in the past [ ] Currently using [ ] Want to use

Thank you for your time.

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Recording Sheet (Control Group) **Participant ID#** _____

Instructions: Use the following log to record your pedometer steps that you take each day. Also note what time of the day you put the pedometer on and when you take it off.

	SUN	MON	TUES	WED	THURS	FRI	SAT
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**						_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm		

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Recording Sheet (Intervention Group) **Participant ID#** _____

Instructions: Use the following log to record your weekly step goal and pedometer steps that you take each day. Try to log onto Web-CT at least twice a week to set your weekly step goal (and submit it) and to record your steps.

	SUN	MON	TUES	WED	THURS	FRI	SAT
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**					**Wk 1 -Step Goal** _____	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm **Wk 2 -Step Goal** _____	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm **Wk 3 -Step Goal** _____	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm **Wk 4 -Step Goal** _____	_____ am _____ pm	_____ am _____ pm
Time on (i.e., 7:30 a.m.) Time off (i.e., 11:30 p.m.) **Pedometer Steps**	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	_____ am _____ pm	

Qualitative Questions for Intervention Group

Questions to answer Research Question 2(A)

(1) Tell me how you are meeting your walking goal.

(2) What encourages you to walk?

(3) What discourages you to walk?

(4) Women often have specific social, economic, or environmental factors that affect their walking. What factors affect your walking?

Questions to answer Research Question 2(C)

(1) You have been involved with the SUU Women on the Move walking program. What about the program has motivated you to stay involved? What has discouraged your involvement?

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Intervention Evaluation

Please help me evaluate this intervention by telling me what you think about it.

(1) Tell me how you feel about using the computer for this program.

_____

_____

(2) What do you think are the strengths of this program?

_____

_____

(3) What suggestions do you have for improving this walking program?

_____

_____

(4) How would you describe your overall feeling about the walking program?

_____

_____

Directions: Read each question carefully and *circle* the number that corresponds to how you would rate the usefulness of each of the program components.

How helpful to you were the following parts of the intervention:					
	Not at all useful	Some what useful	I don't know	Useful	Very useful
Website information on lifestyle activity	1	2	3	4	5
Website information on getting started	1	2	3	4	5
Website information on strategies to overcome barriers	1	2	3	4	5
Website information on choices and strategies	1	2	3	4	5
Use of a pedometer	1	2	3	4	5
Setting goals	1	2	3	4	5
Recording steps	1	2	3	4	5
Walking with a friend	1	2	3	4	5
Walking with a family member	1	2	3	4	5
Walking with a pet	1	2	3	4	5

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INSTRUCTIONS TO PARTICIPANTS

I am interested in finding out how many steps college-aged females walk in their everyday lives; therefore, **do not change from your normal routine** during this week.

DIRECTIONS FOR WEARING PEDOMETER

IMPORTANT:

The lid must be closed all the way (i.e., it clicks/snaps shut) for the pedometer to work correctly and register. The pedometer must remain sealed.

Wear pedometer on dominant hip, close to body, directly over midline of your front thigh. Fasten to belt of waistband (e.g., clipped on pants, skirt or belt). The pedometer tends to fall off of clothing such as polyester, so try to wear non-slick clothing this week. Use your safety strap to help prevent loss of the pedometer.

*NOTE: If you are wearing a dress, you'll need to attach the pedometer to a belt or to your pantyhose/underwear. If you are wearing overalls, attach the pedometer on the front chest pocket of the overalls.

DO NOT wear on the pocket of your pants, or on a jacket or jacket pocket.

PUT THE PEDOMETER ON FROM THE MOMENT YOU GET UP, TO JUST BEFORE YOU GO TO BED. WEAR FOR 7 CONSECUTIVE DAYS.

Only **take off** the pedometer to *shower, swim, and sleep at night.*

Bring the pedometer, so the researcher can record the steps you have taken to _____

_____on _____.

Thank you for participating.

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Weather Data Collection Form

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 Temp: Hum.: Wind: Sun Cldy Prec	**2** Temp: Hum.: Wind: Sun Cldy Prec	**3** Temp: Hum.: Wind: Sun Cldy Prec
4 Temp: Hum.: Wind: Sun Cldy Prec	**5** Temp: Hum.: Wind: Sun Cldy Prec	**6** Temp: Hum.: Wind: Sun Cldy Prec	**7** Temp: Hum.: Wind: Sun Cldy Prec	**8** Temp: Hum.: Wind: Sun Cldy Prec	**9** Temp: Hum.: Wind: Sun Cldy Prec	**10** Temp: Hum.: Wind: Sun Cldy Prec
11 Temp: Hum.: Wind: Sun Cldy Prec	**12** Temp: Hum.: Wind: Sun Cldy Prec	**13** Temp: Hum.: Wind: Sun Cldy Prec	**14** Temp: Hum.: Wind: Sun Cldy Prec	**15** Temp: Hum.: Wind: Sun Cldy Prec	**16** Temp: Hum.: Wind: Sun Cldy Prec	**17** Temp: Hum.: Wind: Sun Cldy Prec
18 Temp: Hum.: Wind: Sun Cldy Prec	**19** Temp: Hum.: Wind: Sun Cldy Prec	**20** Temp: Hum.: Wind: Sun Cldy Prec	**21** Temp: Hum.: Wind: Sun Cldy Prec	**22** Temp: Hum.: Wind: Sun Cldy Prec	**23** Temp: Hum.: Wind: Sun Cldy Prec	**24** Temp: Hum.: Wind: Sun Cldy Prec
25 Temp: Hum.: Wind: Sun Cldy Prec	**26** Temp: Hum.: Wind: Sun Cldy Prec	**27** Temp: Hum.: Wind: Sun Cldy Prec	**28** Temp: Hum.: Wind: Sun Cldy Prec	**29** Temp: Hum.: Wind: Sun Cldy Prec	**30** Temp: Hum.: Wind: Sun Cldy Prec	

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Maintenance Quantitative Data Collection Form - Research Question 2D

Maintenance

Criteria	Group: Control SP	Control UP	I
1. Attendance at pretest data collection (Session 1)			
(Session 2)			
2. Attendance at Web-ct training session	N/A	N/A	
3. Attendance at posttest data collection			
4. Submission of goals	N/A	N/A	
5. Submission of step-recording sheets	N/A		
6. Attendance at data collection during intervention period			
(1)		N/A	N/A
(2)		N/A	N/A
(3)		N/A	N/A
(4)		N/A	N/A

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Sites on Website visited and number of times:

	Number of Times Visited			
Web-CT Site	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Homepage				
Calendar				
Modules				
What is Lifestyle Physical Activity?				
Safety Issues and Tips				
Benefits of Physical Activity				
Choices and Strategies				
Identifying Barriers				
Overcoming Barriers				
How to Wear a Pedometer				
Monitoring Your Progress				
Where to Walk				
Email				
Bulletin Board				
Manage Course				
Track Students				
View Students				
Select Student				
First & Last accessed, # hits				
Distribution				
Homepage hits				
Modules (content)				
Quiz				
Calendar				
Mail				
History				

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APPENDIX C

INTERVENTION CONTENT

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SCT Construct: Behavioral Capability

WHAT IS LIFESTYLE PHYSICAL ACTIVITY?

Lifestyle Physical Activity is the "daily accumulation of at least 30 minutes of self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life" (Dunn, Andersen, & Jakicic, 1998, p. 399). Lifestyle activity should be your choice of activities. It is "exercise with a purpose" and should be fun and enjoyable.

What counts as activity?

- Individual activity (walking, jogging)
- Taking the stairs instead of the elevator
- Parking at the farthest part of the parking lot
- Walking your dog
- Playing with your kids
- Housework (vacuuming, washing windows/floors)
- Gardening (pulling weeds, mowing [non-riding mower] lawn, rake leaves, prune)
- Grocery shopping
- Dancing

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HOW TO START BEING PHYSICALLY ACTIVE

1. Set a goal.
    a. It takes approximately 1 minute to walk 100 steps, 5 minutes to walk 500 steps, and 10 minutes to walk 1000 steps when walking at a 3-4 mph pace.
    b. Figure how many more minutes you will probably need over your baseline steps: *Adding 500 steps to your baseline steps means adding about 5 minutes of additional walking to each day; whereas, adding 3,000 steps to your baseline steps means adding about 30 minutes of additional walking each day.*
2. Determine ways to help meet your goal
    a. See Choices and Strategies
    b. Find ways to add steps to your daily routine through incidental walking.
3. Check your pedometer throughout the day to see how well you are meeting your goal.
4. When thirsty, drink water! No soda's (contain caffeine and sugar, which will dehydrate). No need for sport drinks. Water is best!

FIND WAYS TO ADD WALKING TO YOUR DAILY ROUTINE:

- Do housework
- Work in the garden or mow the grass. Don't use a riding mower!
- Go out for a short walk before breakfast, after dinner or both! Start with 5-10 minutes and work up to 30 minutes.
- Walk to the store instead of driving.
- Stand up while talking on the telephone.

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- Walk the dog
- Park farther away from the grocery store / Wal-mart and walk the extra distance.
- Take the stairs instead of the elevator.
- Plan family outings that include physical activity.
- Make a date with a friend to enjoy physical activity.

SAFETY ISSUES/TIPS

BEFORE YOUR WALK, DON'T FORGET TO STRETCH

- ♥ Always stretch and warm-up before and after your workout.
- ♥ Slow start
- ♥ Stretch
- ♥ Move up to pace
- ♥ Cool down to finish
- ♥ Be sure to stretch at different times during the day (e.g., in the morning, in front of TV, at work, etc.). As little as 5 minutes/day has shown to improve flexibility.
- ♥ Try to stretch daily for 10-15 minutes and hold each stretch for 10-30 seconds--don't bounce or push beyond your comfort zone.

WHY STRETCH?

- ♥ Prevent Injury:
  - Can help prevent injuries and decrease soreness after a workout.

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- ♥ Build Muscle Mass:
    - Stretching not only builds muscles (think about yoga instructors), but it also lengthens muscles so that they look lean and toned.
- ♥ Decrease Stress:
    - Stretching allows you to take time for yourself, and will help you to relax and enjoy life to its fullest!
- ♥ Increase Flexibility:
    - To keep your muscles limber so that you can perform necessary daily tasks with ease.
    - It also helps increase range of motion & coordination.
- ♥ Feels Good/Decrease Pain:
    - If you sit all day, you probably have back, neck, and possibly hand pain.
    - Stretching decreases such pain by improving posture.
- ♥ Increase Body Awareness:
    - You can get to know yourself and your body.
    - It helps your body move for the sake of moving, rather than competition.

Adapted from:
Lila S. Ojeda, MS, RD, LD, CSCS
Bio-nutritionist/Research Associate
General Clinical Research Center
Oregon Health & Science University
Mail Code: CR107
[redacted]

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Safety tips for walkers:

1. ALWAYS WALK ON THE SIDEWALK. IF THERE IS NO SIDEWALK AND YOU HAVE TO WALK IN THE ROAD, ALWAYS WALK FACING TRAFFIC, SO YOU CAN SEE ANY CAR THAT MIGHT GO OUT OF CONTROL.
2. DRESS TO BE SEEN. BRIGHTLY COLORED CLOTHING MAKES IT EASIER FOR DRIVERS TO SEE YOU DURING THE DAYTIME. AT NIGHT, YOU NEED TO WEAR SPECIAL REFLECTIVE MATERIAL ON YOUR SHOES, CAP OR JACKET TO REFLECT THE HEADLIGHTS OF CARS COMING TOWARDS YOU.
3. TIPS FOR CROSSING THE STREET.

    - CROSS ONLY AT CORNERS OR MARKED CROSSWALKS.
    - STOP AT THE CURB, OR THE EDGE OF THE ROAD.
    - STOP AND LOOK LEFT, THEN RIGHT, THEN LEFT AGAIN, BEFORE YOU STEP INTO THE STREET.
    - IF YOU SEE A CAR, WAIT UNTIL IT GOES BY. THEN LOOK LEFT, RIGHT AND LEFT AGAIN UNTIL NO CARS ARE COMING.
    - IF A CAR IS PARKED WHERE YOU ARE CROSSING, MAKE SURE THERE IS NO DRIVER IN THE CAR. THEN GO TO THE EDGE OF THE CAR AND LOOK LEFT-RIGHT-LEFT UNTIL NO CARS ARE COMING. KEEP LOOKING FOR CARS WHILE YOU ARE CROSSING, AND REMEMBER, WALK. DON'T RUN.

SOURCE: HTTP://WWW.NHTSA.DOT.GOV/KIDS/BIKETOUR/PEDSAFETY/

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HOT WEATHER IS COMMON IN CEDAR CITY

WALKING OR JOGGING IN HOT WEATHER PUTS ADDITIONAL STRAIN ON YOUR BODY. CONDITIONS SUCH AS HEAT STROKE ARE MORE LIKELY. SUGGESTIONS INCLUDE:

- DRINK PLENTY OF WATER BEFORE, DURING AND AFTER EXERCISE. TAKE A WATER BOTTLE WITH YOU.
- IF PRACTICAL, PROTECT YOURSELF FROM SUNBURN WITH CLOTHING, SUCH AS LONG-SLEEVED TOPS, FULL-LENGTH TROUSERS, A HAT AND SUNGLASSES.
- APPLY SPF 15+ SUNSCREEN TO ALL AREAS OF EXPOSED SKIN – YOU MAY LIKE TO CONSIDER WATERPROOF VARIETIES.
- REAPPLY SUNSCREEN FREQUENTLY, PARTICULARLY IF YOU ARE SWEATING HEAVILY.
- WALK OR JOG IN THE COOLER PARTS OF THE DAY – PREFERABLY, BEFORE DAWN AND AFTER SUNSET.
- REDUCE YOUR EXERCISE INTENSITY.
- DON'T DRINK ALCOHOL, TEA, COFFEE, OR CAFFEINATED SODAS BEFORE OR AFTER EXERCISING, AS THESE BEVERAGES PROMOTE FLUID LOSS. IF YOU DO CONSUME CAFFIENE, DRINK PLENTY OF WATER TO OFFSET DEHYDRATION.

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WALKING AT NIGHT

YOU MAY FEEL UNEASY OR UNSAFE WHEN EXERCISING AT NIGHT. IT IS NOT RECOMMENDED, BUT IF YOU CHOOSE TO DO SO, SOME SUGGESTIONS INCLUDE:

- WALK WITH A FRIEND.
- STICK TO POPULATED OR WELL-LIT AREAS.
- WEAR BRIGHTLY COLORED CLOTHING SO THAT YOU'RE VISIBLE TO DRIVERS.
- WALK IN THE DIRECTION OF ONCOMING TRAFFIC SO YOU CAN SEE WHAT'S COMING.
- TAKE A FLASHLIGHT WITH YOU.
- CONSIDER ATTACHING REFLECTOR DISCS TO YOUR CLOTHING AND SHOES.
- TAKE A WALKING STICK OR UMBRELLA WITH YOU IN CASE YOU GET MENACED BY AN UNLEASHED AND UNFRIENDLY DOG.

LISTEN TO YOUR BODY

INJURIES ARE MORE LIKELY IF YOU IGNORE YOUR BODY'S SIGNALS OF FATIGUE, DISCOMFORT AND PAIN. SUGGESTIONS INCLUDE:

- MAKE SURE YOU HAVE AT LEAST ONE RECOVERY DAYS EVERY WEEK (IF YOU EXPERIENCE THESE SYMPTOMS).
- IF YOU FEEL BREATHLESS DURING EXERCISE, SLOW DOWN.
- INJURIES NEED REST - TRYING TO 'WORK THROUGH' THE PAIN WILL CAUSE MORE DAMAGE TO SOFT MUSCLE TISSUE AND DELAY HEALING.

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- IF YOU SEEM TO BE SUFFERING FROM MORE COLDS AND INFECTIONS THAN USUAL, YOU COULD BE EXERCISING TOO MUCH - EASE OFF ON YOUR SCHEDULE.

SOURCE:

HTTP://WWW.BETTERHEALTH.VIC.GOV.AU/BHCV2/BHCARTICLES.NSF/PAGES/EXERCISE_SAFETY?OPENDOCUMENT

WHILE YOU ARE WALKING, USE GOOD FORM:

- Always stand up straight
- Head up (chin parallel to the ground looking about 20 feet ahead)
- Suck in your stomach
- Tuck in your behind-rotate your hips forward slightly.

  This will keep you from arching your back.
- Walk with a rolling motion. Strike the ground first with your heel.

  Roll through the step from heel to toe.
- Bend your elbows 90 degrees
- Relax your hands
- With each step, the arm opposite your forward foot comes straight forward, not diagonally
- As the foot goes back, the opposite arm comes straight back
- Keep your elbows close to your body - don't "chicken wing"
- Avoid using hand or ankle weights - they put too much pressure on the joints.
- Wear comfortable clothing.
- Wear comfortable shoes – sneakers are best.

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BENEFITS OF PHYSICAL ACTIVITY

- ♥ Decrease Stress:
    - o Also improves self-confidence,
    - o Relieves tension,
    - o Increases sense of well-being, and
    - o Increases enjoyment of social contacts.
- ♥ Decrease Depression:
    - o Mild to moderate aerobic exercise helps improve mood, anxiety and depression.
- ♥ Weight Management:
    - o Helps to burn calories and can lead to moderate weight loss.
- ♥ Health Parameters:
    - o Decreases risk of heart disease
    - o Lowers total cholesterol and triglycerides,
    - o Increases HDL's ("good" cholesterol),
    - o Decreases risk of Type 2 diabetes,
    - o Lowers elevated blood pressure, &
    - o Decreases risk of certain cancers.

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- ♥ Helps to Maintain Strength and Muscle Mass:
    - o Important for daily activities, and for weight loss (the more muscle you have, the more calories you burn).

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SCT Construct: Self Efficacy

Frame 1

STRATEGIES TO OVERCOME BARRIERS

Review the section called Identification of Barriers for more information on identifying your barriers. Many barriers associated with not getting enough physical activity are related to **time management skills**. If this is a reason you cannot find the time to be physically active, working on this skill will help you become more physically active but also help with your school career.

Barrier	Strategy to Deal With
Lack of Time	Determine your priorities: 1. family, leisure, work success, school success, more time with boy/girlfriend, more time to study, more time with spouse, etc. 2. Track time you currently spend on your priorities. 3. Determine where you can spend time fitting in walking: 4. Increase daily walking around campus. 5. Rearrange schedule to fit in a time to take a 30-minute walk. 6. Walk with a friend or classmate and use the time to discuss current events or schoolwork.
Lack of Facilities	Find ways to increase walking without the need for facilities. See Choices and Strategies to Increase Physical Activity.

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Barrier	Strategy to Deal With
Lack of Equipment	Find ways to increase walking without the need for equipment. See Choices and Strategies to Increase Physical Activity.
Inconvenience	Find ways to increase walking during your normal day. See Choices and Strategies to Increase Physical Activity. If you come up short on your goal, take a short 20 to 30-minute stroll after dinner.

CHOICES AND STRATEGIES

Here are some examples of physical activities you can use to increase your steps/day.

- Walking at a moderate or brisk pace of 3 to 4 mph on a level surface inside or outside, such as
    - Walking to class, work, or the store;
    - Walking for pleasure;
    - Walking the dog; or
    - Walking as a break from work.
- Playing with your children, such as
    - Roller skating or in-line skating
    - Jumping on a trampoline
    - Playing on school playground equipment, moving about, swing, or climbing
- Enjoying a sport or recreation
    - Table tennis
    - Tennis, doubles
    - Any type of dancing: ballroom, line, folk, modern
    - Golf (without the cart!)

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  - Basketball (shooting baskets)
  - Coaching children's or adults' sports
- Playing instruments while actively moving
- Singing while actively moving, as in church
- Gardening and yard work
  - Raking the lawn
  - Hoeing
  - Weeding while standing or bending
  - Trimming shrubs and tress
  - Pushing a power lawn mower or tiller
- Moderate housework
  - Scrubbing the floor or bathtub
  - Hanging laundry on a clothesline
  - Moving light furniture
  - Walking and putting household items away
  - Putting groceries away
- Occupational physical activity, such as
  - Waiting tables or institutional dishwashing
  - Patient care: bathing, dressing, and moving patients

Source: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. (1999). *Promoting physical activity: A guide for community action.* Champaign, IL: Kinetics.

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SCT Construct: Self-regulation

HOW TO WEAR THE PEDOMETER

IMPORTANT:

The lid must be closed all the way (i.e., it clicks/snaps shut) for the pedometer to work correctly and register.

HOW TO WEAR THE PEDOMETER:

- ♥ Wear pedometer on dominant hip, close to body, directly over midline of your front thigh.
- ♥ Fasten to belt of waistband (e.g. clipped on pants, skirt or belt).
- ♥ It should fit snug to your body and not hang loose. The pedometer tends to fall off of clothing such as polyester, so try to wear non-slick clothing during this program.
- ♥ *NOTE: If you are **wearing a dress**, you'll need to attach the pedometer to a belt or to your pantyhose/underwear.
- ♥ **DO NOT wear on the pocket of your pants, or on a jacket or jacket pocket.**

Put the pedometer on from the moment you get up, to just before you go to bed.

CARING FOR YOUR PEDOMETER:

- ♥ Avoid dropping or crushing, this could break the pedometer.
- ♥ Avoid excessive moisture, the pedometer is not waterproof.

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- ♥ Avoid forcing the pedometer clip onto a belt or pant waist, this could cause the clip to break.

IDENTIFICATION OF BARRIERS

Reasons people do not exercise is that they either have many barriers that prevent them from exercising, or they have many excuses as to why they don't exercise. Take a moment to check out this website:

http://www.cdc.gov/nccdphp/dnpa/physical/life/orvercome.htm

It gives information on different kinds of barriers. Take the quiz, "Barriers to Being Active" at http://www.cdc.gov/nccdphp/knpa/physical/life/barriers_quiz.pdf

What are the barriers that affect you the most?

How can these barriers be reduced so that you can meet your step goal?

(LINKS TO THESE SITES WILL BE MADE ON THE WEB-CT)

MONITORING YOUR PROGRESS

HOW MANY STEPS ARE ENOUGH?

A study by Drs. Tudor-Locke and Bassett found that:

- sedentary people get <5,000 steps,
- inactive people get between 5,000 to 7,499 steps,
- somewhat active people get 7,500 to 9,999 steps, and
- active people get ≥ 10,000.

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However, it important to take into account your personal baseline steps and make a goal to increase your steps by 1,000, 2,000 or 3,000 over your baseline steps. This is a realistic way to increase your physical activity without setting yourself up for failure or disappointment.

GENERAL IDEAS ABOUT WRITING GOALS:

1. Be Specific: Instead of writing, "I want to walk more", write "I want to walk 5,000 steps each day for 5 days of this week."
2. Be Measurable: Again, the more specific you are in your goal with exact numbers, it will be easier to evaluate if you have met your goal.
3. Be Action-oriented: This is "how" you will meet your goal. You do not have to write these "how" sub-goals on your weekly goal sheet, but you should be aware of them; like, "by taking the stairs instead of the elevator" or "by taking my dog on a walk every evening".
4. Be Realistic: Set goals that are challenging, but possible. For example, don't set unrealistic step goals (10,000 steps per day) if your baseline pedometer steps were 2,000 per day.
5. **Plan rewards** (other than what the program gives) **for meeting your goals.** Don't use food. Choose things that are important so you'll look forward to meeting your goals – a movie, a concert, a new dress!

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Setting Personal Activity Goals With Pedometers

1. Find your baseline activity level. (available from program manager)

2. Calculate your personal step-count goal as shown:

Baseline	Personal Goal (1000 – 3000 steps plus your baseline)	Goal for Week
For example		
3,000	3,000 + 1,000 steps = 4,000	4,000
Okay, now		Week 1
you try:		

3. Each week, take the goal you had for the previous week and add 1,000 steps. For example, if my goal for week 1 was 4,000. The next week, I would calculate: 4,000 + 1,000 = 5,000 steps (new goal for week 2).

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SCT Construct: Environment and Situation

WHERE TO WALK

There are a few things you can do to be more successful at walking.

1. Find a friend, spouse, or other person to be your walking buddy.
2. Make walking fun!
3. Make walking part of your daily life. Find ways to increase the incidental steps you take when doing usual things.

Here are some links that you will find helpful:

- Canyon Trail Map – step counts
- Campus Map – step counts
- SUU track
- Cedar High track
- Cedar Middle track
- Utahwalks.org

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Forms/Evaluation

Step Goal for the Week

Name: Lynne Ornes (Preview)
Start time: March 15, 2005 1:06pm
Number of questions: 3

Question 1 (1 point)

Which week is this goal for?

- a. 1
- b. 2
- c. 3
- d. 4

Save answer

Question 2 (1 point)

What are your baseline steps? (given to you during the training class)

Answer:

Save answer

Question 3 (1 point)

How many steps are you adding to your baseline steps for this week (1000 to 3000)?

Answer:

Save answer

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Recording Sheet

Name: Lynne Ornes (Preview)
Start time: March 15, 2005 1:08pm
Number of questions: 22

Question 1 (1 point)
Which week is this recording sheet for? (week 1, week 2, week 3, week 4)

Answer:

Save answer

Question 2 (1 point)
How many steps did you take on Friday?

Answer:

Save answer

Question 3 (1 point)
On Friday, at what time did you put the pedometer on?

Answer:

Save answer

Question 4 (1 point)
On Friday, at what time did you take the pedometer off?

Answer:

Save answer

Question 5 (1 point)
How many steps did you take on Saturday?

Answer:

Save answer

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Question 6 (1 point)

On Saturday, at what time did you put the pedometer on?

Answer:

Save answer

Question 7 (1 point)

On Saturday, at what time did you take the pedometer off?

Answer:

Save answer

Question 8 (1 point)

How many steps did you take on Sunday?

Answer:

Save answer

Question 9 (1 point)

What time did you put the pedometer on?

Answer:

Save answer

Question 10 (1 point)

When did you take the pedometer off?

Answer:

Save answer

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Question 11 (1 point)

How many steps did you take on Monday?

Answer:

Save answer

Question 12 (1 point)

On Monday, what time did you put the Pedometer on?

Answer:

Save answer

Question 13 (1 point)

On Monday, when did you take the pedometer off?

Answer:

Save answer

Question 14 (1 point)

How many steps did you take on Tuesday?

Answer:

Save answer

Question 15 (1 point)

On Tuesday, at what time did you put the pedometer on?

Answer:

Save answer

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Question 16 (1 point)

On Tuesday, at what time did you take the Pedometer off?

Answer:

Save answer

Question 17 (1 point)

How many steps did you take on Wednesday

Answer:

Save answer

Question 18 (1 point)

On Wednesday, at what time did you put the pedometer on?

Answer:

Save answer

Question 19 (1 point)

On Wednesday, at what time did you take the pedometer off?

Answer:

Save answer

Question 20 (1 point)

How many steps did you walk on Thursday?

Answer:

Save answer

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Question 21 (1 point)

On Thursday, at what time did you put the pedometer on?

Answer:

Save answer

Question 22 (1 point)

On Thursday, at what time did you take the pedometer off?

Answer:

Save answer

Finish Help

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Calendar

Month: September

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
	Training for WebCT Must attend 1 training session during this time. Training session takes approximately 1 hour.			WEEK 1 Submit Weekly Step Goal (1)	**Start walking activity**	Log into Web-CT to review the following: 1. What is Lifestyle Physical Activity? 2. How to Start Being Physically Active, 3. How to set Goals, and 4. Using a Pedometer
				WEEK 2 Submit Weekly Step Goal (2)	Submit weekly recording sheet (1)	Log into Web-CT to review the following 1. Benefits of Physical Activity 2. Choices and Strategies 3. Barriers, Examples of Barriers, and How to Deal With Barriers 4. (visit web site listed on Web-CT) Complete and submit question on your personal barriers
				WEEK 3 Submit Weekly Step Goal (3)	Submit weekly recording sheet (2)	Log into Web-CT to review the following: 1. Safety tips for Walkers 2. Hot Weather 3. Walking at Night 4. Links to walking sites/maps
				WEEK 4 Submit Weekly Step Goal (4)	Submit weekly recording sheet (3) Submit weekly recording sheet (4)	Log into Web-CT to review the following: Any sites you wish to review. Complete and submit evaluation of Web-CT site
	Meet to return pedometers and complete one questionnaire					

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APPENDIX D

RECRUITMENT MATERIALS

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Recruitment Script

Hello, my name is Lynne Ornes and I am a doctoral student in the College of Nursing at the University of Utah. I would like to invite you to take part in a study to see if an internet-based walking program can increase the amount of walking done by females in colleges. This is an experimental study, which means that some of the students will be in the program (the walking program) and some of the students will serve as a control group. The control group will not have access to the program at first but may participate in the program later.

The purpose of this study is to see if a walking program given through the internet will be effective in encouraging college females to increase the amount of walking they do.

This study is important because it has been found that females do not get enough physical activity. Females in college are especially sedentary. Physical activity has been found to have many benefits. It

- Helps decrease stress so that you can study better and get better grades
- Helps prevent weight gained in the college years
- Makes you feel and look better, and
- Helps reduce the risk of developing chronic diseases, such as:
    - Heart disease (which is the number one killer of women)
    - Breast Cancer, and
    - Diabetes

Participating in this program will help you become familiar with Web-CT, an internet-based learning tool that is used at this college. Additionally, it will help you to begin and

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monitor an exercise program that is based on your lifestyle and in which you can live with! Lastly, gift certificates to University Bookstore will also be given to students who participate in the study.

This program will be conducted over an 8-week period. The time involved for your participation would be about 1 ½ hours per week. You will be asked to wear pedometers to monitor the steps you take. Additionally, there are four short surveys to fill out. Lastly, if in the internet group, you will log on to the walking-program Website, browse the site, fill out short goal statements, and monitor your pedometer steps. There will also be some e-mailed questions and a short survey you will be asked to respond to that will help me to evaluate the usefulness of the program.

Thank you

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Recruitment Questionnaire

Participant ID# _____

Please Tell Me Why You Are Doing This Program

Directions: Please read each question carefully and write a short response. The lines on the paper are just a guide; you do not need to fill the whole space!

(1) Tell me what the reasons you signed up for this program are.

_____

_____

_____

_____

_____

_____

(2) What do you think are the most effective methods of recruitment (poster, visits by program director, brochure) used for this program?

_____

_____

_____

(3) What suggestions for incentives do you have that would be better or more useful to participants in this program?

_____

_____

_____

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DEMOGRAPHICS FORM

Name: _____

Address: _____ City: _____UT Zip: _____

Phone: _____

Email address (please print carefully): _____

For Investigator Use Only:
Participant ID# _____

Instructions: Please read each item carefully. Select the **ONE best** response or fill out as completely as possible.

1. Date of Birth (dd/mm/yr) ___/___/ ___

2. How tall are you? ___feet ____inches

3. How much do you weigh? _____ pounds

4. What is your ethnicity?

☐ Caucasian	☐ Native American
☐ African-American	☐ Hispanic
☐ Pacific-Islander	☐ Other (please specify)_____

5. Academic Major within the College of ___:

☐ Science	☐ Physical Education
☐ Education	☐ Visual or Performing Arts
☐ Humanities	☐ Business
☐ Undecided	☐ Other (please specify)_____

6. Academic Year

☐ Freshman	☐ Junior
☐ Sophomore	☐ Senior

7. How many credit hours are you enrolled in this semester? _____

8. Housing:
   - ☐ Live at home with parents/grandparents
   - ☐ Live at own home/apartment – alone
   - ☐ Live at own home /apartment – with roommate(s) or significant other
   - ☐ Live in dormitory

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9. What is the primary way that you usually get to school?
   - ☐ Walk
   - ☐ Bike
   - ☐ Bus
   - ☐ Car

10. Employment status
   - ☐ Not currently working
   - ☐ Working part-time
   - ☐ Working full time

11. What is your annual household income?
   - ☐ Less than 20,000
   - ☐ 20,000 to 39,999
   - ☐ 40,000 to 69,999
   - ☐ greater than 70,000

12. Which of the following best describes your thoughts about physical activity?
   - ☐ Male activity
   - ☐ Waste of time
   - ☐ Good for health
   - ☐ Other, specify _____

13. Current Marital Status
   - ☐ Never Married or Partnered
   - ☐ Married or Partnered
   - ☐ Divorced
   - ☐ Separated
   - ☐ Other, specify _____

14. Do you have children?
   - ☐ Yes ___
   - ☐ No ____ If NO, you are done.

15. If yes, how many children are **living at home with you**:
   - ☐ Girls _____
   - ☐ Boys _____

This completes this questionnaire.
Thank you for your time.

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Recruitment Quantitative Data Form - Research Question 2C

Recruitment Information			
Class/orientation (list class name, professor, days & times class meets)	# total F in class	# total F eligible for study	# total F who consent

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$$\frac{\text{Actual participants (those in study)}}{\text{Potential participants (eligible)}} \times 100 = _____\%$$

$$\frac{\text{Ending participants}}{\text{Beginning participants}} \times 100 = _____\%$$

Beginning number of participants	Ending number of participants

Catalog of Recruitment Measures		
Method	**#**	**Where Displayed**
Print Media:		
Flyers		
Newspaper Ads		
Posters		
Type of Visits	**#**	**Description**
Classes		
Student Orientations		
Other (i.e. dorms)		

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WALKING IS HAZARDOUS TO HEART DISEASE, DIABETES, & BREAST CANCER

The **SUU Women on the Move Project** is looking for women between the ages of 18 and 34 who want to feel better, fit into their clothes better, and learn an activity that will help keep them healthy for life.

Come be part of our Study!

- **COMING FALL 2005!**
- **Convenient (1 ½ hours for 8 weeks**
- **No classes to attend**
- **No cost**
- **No weighing or measuring**
- **Incentives given for participating**

Are You . . .

- **Not very physically active?**
- **Able to walk unassisted?**
- **Comfortable using the internet?**

SIGN UP TODAY

Contact: Lynne Ornes, RN, MS

[redacted]

APPENDIX E

INFORMED CONSENT

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PARTICIPANT CONSENT

BACKGROUND:

You are invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives, if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether you would like to volunteer to take part in this research study.

Inactivity is a major public health concern in this country. Females are more inactive than others. Walking is an important way to increase your physical activity because it is something most everyone does during their daily life and can be helpful to your health. The purpose of this study is to test whether the internet can be used to deliver a program to increase lifestyle physical activity (walking) in college-aged females. By signing this consent form, you agree to participate in this study by participating in a control or intervention group.

STUDY PROCEDURE:

This is an experimental study. Sometimes, because we do not know which way of teaching students is best, we need to make comparisons. Students will be put into groups and then compared. A computer decides which students are in which groups and has no information about the individual –i.e. by chance. You have a 50-50 chance of getting into the intervention group. You may be assigned to an intervention or a control group. There will be no treatment given to the control group. After consenting to participate in this study, you will be asked to do the following over an 8-week period:

A. Complete a questionnaire of 9 items that ask you about age and school demographics. It should take you no more than 10 minutes to complete.

B. Complete a questionnaire of 10 items that ask you about why you are doing this study. It should take you no more than 5-10 minutes to complete.

C. Wear a sealed pedometer that counts the number of steps you take in a day. The pedometer should be worn for exactly 7 days to obtain baseline-walking behavior. The pedometer should be worn at all times, except for sleeping, showering, and swimming. As soon as you wake up each morning, put the pedometer on your belt or waistband. Just before you go to bed each night, please remove the pedometer. If chosen for the intervention group, you will continue to wear the pedometer each day for 4 weeks to monitor your walking activity. If chosen to be in the control group, you will wear a sealed pedometer so that you cannot see the number of steps you have walked and meet with the researcher weekly to record steps or wear an unsealed pedometer so that you can see the number of steps you have walked and record steps yourself.

D. At the beginning and the end of study, complete a scale of 15 items that ask you about how confident you feel about being able to increase your physical activity. It should take you no more than 20 minutes to complete.

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There are no right or wrong answers, so please be as honest as possible when filling out the questionnaire and recording sheet. If you feel uncomfortable giving answers to certain parts of the questionnaire, it is okay to skip that part. The resulting data from all questionnaires and recording sheets will be entered into a software program that will help find out if there is a difference between the study groups in their level of activity.

RISKS:

A potential, but unlikely, risk of participating in this study is that as you increase your activity for the study, you may be aware of mild muscular soreness in your lower body. Other risks are that you may feel uncomfortable talking about how much you walk. The time required completing the questionnaire, recording sheet, and internet activities may pose a problem for you. Lastly, the time required to walk to meet a daily goal may pose a problem for you.

BENEFITS:

I cannot promise any benefits from your being in the study. However, possible benefits include becoming more aware of the amount of walking and other physical activity that you do. It has been shown that when one monitors a behavior, they become more aware of the behavior and this awareness increases their chance of modifying the behavior. You will also be provided with the written results of your walking activity, if you wish. An additional benefit is in gaining experience in using the internet (and Web-CT), which can be useful for future classes that use this type of learning activity. The information I get from this study may help to determine if an internet-based program is effective in increasing walking in females attending colleges.

ALTERNATIVE PROCEDURES:

If you do not want to be in the study, you may choose not to participate.

CONFIDENTIALITY:

All information, which is collected, about you during the course of the research will be kept strictly confidential. Your name, address, phone numbers, email and student I.D. number will be collected but not used, as a study number will be created instead. Your name and other identifying information will be kept in a locked file and destroyed after the data is analyzed. The data will be kept in a locked file. Results of the study may be published; however, your name and other identifying information will be kept private.

PERSON TO CONTACT:

If you wish to discuss anything related to this study, you may call Lynne Ornes at [redacted] or [redacted]) at any time. If I am not there, leave a message and I will return your call. You may also e-mail me at [redacted].

INSTITUTIONAL REVIEW BOARD:

If you have questions regarding your rights as a research subject, or if problems arise which you do not feel you can discuss with the Investigator, please contact the Institutional Review Board Office at [redacted]

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UNIVERSITY'S LIABILITY STATEMENT:

If you are injured from being in this study, the University of Utah can give you medical care. This medical care will be given to you immediately for emergency problems. The University will not charge you for this medical care, but we will bill your insurance company if you have insurance. If you sign this document, you are not giving up your right to take legal action against the University or other companies involved with this research.

The University of Utah is a part of the government. If you are injured in this study, and want to sue the University or the doctors, nurses, students, or other people who work for the University, special laws may apply. The Utah Governmental Immunity Act is a law that controls when a person needs to bring a claim against the government, and limits the amount of money a person may recover. See Section 63-30-1 through 63-30-38 of the Utah Code.

VOLUNTARY PARTICIPATION:

Participation in the study is voluntary. You may withdraw from the study at any time without penalty. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This will not affect the relationship you have with the investigator, instructor or grade received in any course.

UNFORESEEABLE RISKS:

There may be risks unknown at the present time, but every effort will be made to minimize such risk.

RIGHT OF INVESTIGATOR TO WITHDRAW:

You may withdraw from the study at any time without penalty. Investigator Ornes can withdraw you without your approval. Possible reasons for withdrawal include illness or injury interfering with walking behaviors during the 8-week study period.

COSTS TO SUBJECTS AND COMPENSATION:

There are no costs to you as a participant in this study. In order to compensate you for participating in the study, $5.00 gift certificates to the University Bookstore will be given to you if you are in the intervention group each week (for a total of $20.00) on submission of goals and steps, (2) $20.00 gift certificates to the University Bookstore will be given to you if you are in the control group upon completion of time-2 data collection, and (3) at the end of the study, all participants who completed time-2 data collection will be entered into a drawing for 2 - $50.00 Wal-Mart Shopping Cards. Several instructors will help make participation part of your completion of the course requirements in some of their courses (e.g. it will qualify for the ISP assignment for university success course, Honors College students can get an independent study credit, and it qualifies as a way to earn participation points in nursing classes). You will also be provided with the written results of your walking activity for the weeks, if you wish. You will be assisting me to better understand if using the internet for a physical activity program is effective in increasing the walking behavior of female college students and you will be involved in research that will help you to see your current patterns of walking.

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NEW INFORMATION:

Sometimes during the course of a research project, new information becomes available about the treatment that is being studied. If this happens, the investigator will tell you about it and discuss with you whether you want to continue in the study.

NUMBER OF SUBJECTS:

I expect that 142 female college students from Southern Utah University will participate in this study.

CONSENT:

I confirm that I have read and understand this consent document and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. I will be given a signed copy of the consent form to keep.

I agree to participate in this research study as you have explained in this document.

_____
Participant's Name

_____ _____
Participant's Signature Date

Lynne L. Ornes, RN, MS
Name of Person Obtaining Consent

_____ _____
Signature of Person Obtaining Consent Date

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APPENDIX F

EXTRA CREDIT CONTRACT

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Contract

to Participate in

"SUU Women on the Move" Study

I, _____, resolve to commit to completing the "SUU Women on the Move" study over the next 8 weeks. By signing this contract, I will commit to keeping in touch with Lynne Ornes, the program director, and completing assignments for the group I have been assigned (control or intervention). I understand that in completing this study, I am entitled to:

(1) gift certificates to the SUU University Bookstore and

(2) credit in _____'s class _____.
(name of professor) (number and name of class)

_____ _____
Signature (participant) Date

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