The Physical Educator Vol. 71 • pp. 442–458 • 2014

METHODOLOGY

Text Messaging as a Tool to Increase Physical Activity in College Students

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Abstract

The purpose of this study was to assess the effectiveness of text messaging with pedometer intervention for increasing physical activity of college students. Using a two-group prospective randomized intervention-based design, the researchers gave 201 college students pedometers and divided them into intervention and control groups. The intervention group received motivational text messages for 10 weeks; the control group received none. Pre- and post-measures included height, weight, and waist circumference.

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Acknowledgement. The authors would like to thank the faculty of the Dimension of Wellness classes for their tireless support and ever-present encouragement with this project.

Daily step counts were collected at three intervals. Total standardized steps were not significantly different between groups. Steps for resident students were higher than for commuter students, suggesting that residents had higher levels of physical activity ($p = .003$). Text messaging was not effective in increasing physical activity when used with pedometers.

The well-being of the United States depends upon protecting the health of children and youth. Obesity is increasingly recognized as the common denominator in a host of overlapping risk factors (e.g., high blood pressure, abnormal lipid and glucose panels) that predict risk for heart disease, diabetes, and cancer. Recent evidence has suggested that physical fitness may moderate the effects of obesity in coronary artery disease and that physical fitness may be more important than weight in preventing cardiovascular disease (Wessel et al., 2004). Current national guidelines emphasize the importance of increasing physical activity (PA) through increased walking as a mechanism for controlling weight gain and represent a shift in emphasis from weight loss to weight maintenance.

Methods to motivate youth and young adults to engage in PA for the long term have not been studied much. Strategies, including using pedometers, to increase PA are well documented. In a systematic review of 26 studies involving adult populations, pedometer use significantly increased the number of daily steps and decreased weight and systolic blood pressure (Bravata et al., 2007). Modest weight loss averages of .5 kg per week were found in a meta-analysis of nine studies of pedometer use (Richardson et al., 2008). Findings from studies of college students have suggested pedometer use incorporated into class participation requirements may positively influence weight loss (Jackson & Howton, 2008).

An emerging area of study is using e-mail and text messaging as an effective form of communication to facilitate lifestyle changes in exercise and diet (Gerber, Stolley, Thompson, Sharp, & Fitzgibbon, 2009; Newton, Wiltshire, & Elley, 2009). Former Surgeon General C. Everett Koop (1995) suggested that technology, specifically in communication and information transfer, would advance public health especially among younger populations. Intuitively, the mobile phone device seems a likely candidate for transfer of health information to youth as almost three fourths of all teens (72%) use text messaging to communicate with family and friends; approximately 54% text daily (Lenhart, Ling, Campbell, & Purcell, 2010).

Furthermore, 1 in 3 teens sends greater than 100 text messages daily with girls aged 14 to 17 text messaging more frequently than boys. Finally, 50% of Latinos aged 16 to 25 text message friends daily (Lopez & Livingston, 2010).

A study that examined the level of awareness of cardiac risk among college students discovered that young adults typically obtain the majority of their health information from the Internet and magazines (Muñoz et al., 2010). This finding offers support for testing nontraditional communication methods, such as text messaging, in modifying behavior in college students. The purpose of this study was to assess the effectiveness of combining text messaging with pedometer intervention for increasing PA of college students.

Being overweight is a risk factor that often begins in youth (Chen et al., 2000). Findings from the 2003–2004 National Health and Nutrition Examination Survey reported a 6% to 8% increase in the number of overweight children and adolescents compared to data from their 1988–1994 survey, which revealed that 11% of this population was overweight (Centers for Disease Control and Prevention, 2010). National statistics indicate that 34% of adults in the United States are obese (body mass index [BMI] > 30) and another 35% of adults are overweight (BMI 25–29; Centers for Disease Control and Prevention, 2010).

The decline in PA among younger adolescent females also has been documented. Kimm, Glynn, Kriska, and Barton (2002) conducted a longitudinal study of changes in PA among a convenience sample of 1,213 black and 1,166 white girls aged 9 to 10. BMI was directly associated with decreased PA scores for both races. By ages 18 and 19, most subjects engaged in no form of habitual PA other than school-based activities. Black girls had two times the decline in activity as white girls.

Most clinical intervention programs focus on weight reduction, producing negative energy balance to achieve weight loss. An alternative strategy considered viable for addressing the obesity epidemic long term is preventing weight gain through modifying energy balance. Incremental increases in PA through walking are a strategy to modify energy balance, which holds promise in reducing obesity (America on the Move, 2008; U.S. Department of Health and Human Services, 2011). A wealth of research has recognized that PA is effective in modifying cardiovascular risks due to being overweight or obese, but most studies have addressed older populations. Effective interventions to motivate college students, a high-risk group for sedentary behavior, are lacking.

Hill (2006) attributed the increasing rates of obesity to factors in the food environment and the PA environment. Aggressive advertising, large portion sizes, and the acceptance of eating anytime and anywhere contribute to increased caloric intake. In addition, an environment that does not require PA for transportation to work combined with the prevalence of leisure activities involving television and computers contributes to decreased energy expenditure.

Changes in the external environment over the last several decades have contributed to the obesity epidemic by encouraging overeating and discouraging PA (Hill, 2006). The availability of inexpensive, calorie-dense food has increased. In relation to the costs of other goods and services, food prices have dropped 38% since 1978. In comparison, the cost of fresh fruits has increased by 190%, the cost of vegetables by 144%, and the cost of dairy products by 82% (Finkelstein & Zuckerman, 2008).

Behavioral factors that have contributed to the obesity epidemic include changes in lifestyle choices in the changing environment (Hill, 2006). In an agrarian society such as an Amish community, the average number of steps per day is 18,000 for men and 14,000 for women. In contrast, in the current technological environment where labor-saving devices are prevalent, the average number of steps per day is 5,940 for men and 5,276 for women. Finkelstein and Zuckerman (2008) cited economic reasons for behavior changes. In the workplace, mechanization and technology have lowered the cost of producing goods and services, but they have raised the cost of PA. Exercising now costs time and money and is not built into daily activities. The suburban sprawl has limited the possibility of walking to work, stores, or school.

Physical Activity in College Students

A growing number of descriptive studies have examined cardiovascular risk factors among college populations (Huang et al., 2003; Snow, Sparling, & Beavers, 1999). Similarly, Buckworth and Nigg (2004) examined the relationship among PA, exercise, and sedentary behavior among 493 college students aged 18 to 24. Findings revealed that computer use for men and television watching for women correlates inversely with PA and exercise.

Butler, Black, Blue, and Gretebeck (2004) described findings from a pretest–posttest one-group design study of a convenience sample of 54 primarily white college freshmen women. Subjects increased body weight, decreased caloric intake, and decreased PA over the first semester of college. The increase in fat mass and de-

creased fat-free mass among subjects was consistent with reduced fitness due to decreased PA. Han et al. (2008) studied 69 females at a university in the south central United States and reported a significant decline in PA in the summer between high school and college and another decline during the first semester of college.

Kemper and Welsh (2010) studied 106 students at a historically black college and used pedometers and a questionnaire. Survey results showed that only 28% engaged in moderate PA and 41% engaged in vigorous activity. Students who self-reported low levels of PA were more likely to participate in pedometer use. Results of this study also suggested a small amount of variation in steps taken ranging from low levels of PA (i.e., fewer than 5,000 steps per day) taken by 8.3% to 11.5% of the subjects to 10,000 steps per day, taken by the majority of the subjects. These data provide a baseline level for steps taken in this population of college students.

Jackson and Howton (2008) studied 209 college students whose weights ranged from underweight to overweight and were issued a pedometer as part of a wellness class. The group was 70% women, 22% of ethnic minority, with a mean age of 24.3 ± 7.8 years. The subjects were given a curriculum-based PA intervention as part of the class with instructions on goal setting, methods by which to change behavior, and resources to make changes in activity. Their activity level was assessed by self-report and pedometer records at Weeks 1, 6 and 12. The most significant findings the researchers reported were the steady increase across time for all three groups (i.e., underweight, normal weight, and overweight). Steps per week began with an average of 7,013 steps per day, increased to 9,000 steps per day in Week 6, and increased to almost 10,000 steps per day by Week 12. These results support using a pedometer intervention to increase ambulation in college students. Because the greatest increase in the steps occurred between Weeks 1 and 6, the researchers posited that even a brief intervention may result in an increase in activity in this population.

Bravata et al. (2007) conducted a systematic review of 26 studies (eight randomized control trials and 18 observational studies) to determine the association of pedometer use with an increase in PA and improved health. The studies included 2,767 subjects, 85% women, with a mean age of 49 years. The mean intervention period was 18 weeks. Findings from this study revealed that pedometer users increased their PA by 26.9% over baseline. In addition, the researchers found that having a step goal, such as 10,000 steps per day, was a predictor of PA. They concluded that using pedometers

is significantly associated with increases in PA and significant decreases in BMI and blood pressure.

Alternative Strategies for Influencing Health-Related Behaviors

Traditional methods of influencing health-related behaviors focus on face-to-face interactions and printed materials. Evidence has suggested young adults do not have strong participation rates in such support methods, but alternative means of communication may be effective in this population. Using alternative strategies (e.g., mobile phone text messaging, pager system, e-mail messages) has increased patient compliance in some studies (Bamberger et al., 2000; Cavannaugh, White, & Rothman, 2007; Ritterband et al., 2005). The extensive use of mobile phones and text messaging has been documented among youth. Leena, Tomi, and Arja (2005) found that 85% of adolescent boys and 93% of girls carried and used mobile phones daily. All study subjects used text messages daily.

Franklin, Waller, Pagliari, and Greene (2006) successfully implemented a mobile phone text messaging system called *Sweet Talk* to remind adolescents with diabetes to check their blood glucose levels and administer their insulin. It was an acceptable and effective form of communication for study participants. Gerber et al. (2009) examined the feasibility of providing multiple text messages each day during a study on weight maintenance in African American women. Findings demonstrated that text message delivery was cost effective, feasible, and widely accepted by the participants. Researchers concluded this communication method has potential for promoting healthy behaviors even when face-to-face interactions in long-term weight loss programs are reduced.

A major limitation of most previous studies was the use of self-report for PA. A strength of this current study is the use of objective measures to determine level of PA and physiologic outcomes as detailed in the methodology section.

Methods

Setting and Sample

The setting was an urban, private, Catholic, Hispanic-serving university in south Texas. A two-group, prospective, randomized, intervention-based design was used. Eligible participants were enrolled in a wellness course, were at least 18 years old, and had a cell phone with unlimited text messaging. College athletes and students

with serious health problems or disabling conditions were excluded. With an alpha of .05 and power of 80%, 99 students were needed in each group to detect a difference between intervention and control groups of 1,000 steps per student per day. The sample size was 100 in the intervention group and 101 in the control group. The sample was 64% female and 64% Hispanic with mean age of 21 years. Sixty-eight percent of the students were commuters, with 32% residing in campus-based housing (see Table 1). Analysis of data was done using percentages, means, and standard deviations, chi square, *t* test, multiple regression modeling, correlations, and ANOVA.

Table 1
Description of Treatment and Control Groups

Demographic variable	Treatment *N* (%) or *M* ± *SD*	Control *N* (%) or *M* ± *SD*	*p*[a]
Gender			
Male	36 (36)	36 (36)	
Female	65 (64)	63 (64)	.916
Age (months)	250 ± 40	251 ± 43	.928
Race/ethnicity			
Hispanic	65 (64)	63 (64)	
White	15 (15)	26 (27)	
African American	13 (13)	6 (6)	
Asian/Pacific Islander	4 (4)	1 (1)	
Other	4 (4)	2 (2)	.092
Living arrangement			
Resident	29 (29)	33 (34)	
Commuter	70 (71)	64 (66)	.577

[a]Chi square or independent samples *t* test.

The university Institutional Review Board for Protection of Human Subjects approved the study prior to implementation. Subjects who met inclusion criteria in the wellness classes were eligible to participate. Students who volunteered for the study read and signed a consent form. The participants were issued a pedometer at the beginning of the study, and baseline physical data (height, body weight, BMI, and waist circumference) were collected. Study participants received an orientation to the benefits of exercise, an overview of

data collection procedures, and training in using the pedometer. Students then were assigned randomly using a computerized program to an intervention or control group. The intervention group received brief text messages that were delivered two to three times per week over 16 weeks of the semester with suggestions for implementing healthy behaviors (see Table 2).

The control group received no text communication. At 4-week intervals, investigators downloaded each participant's pedometer data into a study database and reset the pedometers during a wellness class period.

Instruments

Trained nursing and wellness faculty, who followed a protocol for data collection, collected demographic data and objective physiologic measures (height, weight, waist, and skinfold measurement). Height was determined to the nearest quarter inch with a wall-mounted device, and an electronic scale was used for weight, which was measured to the nearest tenth pound. Waist measurements and BMI were assessed and calculated following the National Heart, Lung, and Blood Institute (1998) guidelines. The pedometer selected for the study was the OMRON GOsmart™ Pedometer Model HJ-720ITC PC version. The pedometer is capable of tracking the number of steps taken over time, the total distance covered, and total calories expended.

Results

Fifty-nine students in the intervention group and 55 in the control group completed the study. The students who completed the study did not differ significantly from those who did not complete the study by age, gender, race/ethnicity, living arrangement (resident vs. commuter), or pretest physiologic measures (weight, height, waist, skinfold, BMI). Similarly, the intervention and control groups did not differ significantly on these attributes. Table 3 provides a description of the sample stratified by gender and group assignment (treatment and control).

Mean daily steps per student were 6,164 and 6,458 for the intervention and control groups, respectively (see Figure 1). The intervention and control groups did not differ significantly in PA as measured by number of steps ($p = .467$). However, males had 7,424 mean steps per day compared to females with 5,189 ($p < .001$), and resident students had 7,333 mean steps per day compared to commuter students with 5,863 ($p = .001$).

Table 2
Examples of Text Messages and Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1	Today is a new day! Don't forget to wear your pedometer!		Have three servings of dairy products today and every day to stay fit.		Did you get all your steps this week? Don't forget to download!	
Week 2		You are doing great! Take the stairs to class this morning.		Grab some yogurt for a snack today.		Take a walk in the park to get all your steps in before you download tonight.
Week 3	Get to school early and park on the hill so you can get your steps in before class!		Fruit salad makes a great snack!		Come to the education session on Monday in Main Hall. Pick up freebies to help you stay on track!	
Week 4		Try a breakfast bar instead of a taco today.		If it's raining get your steps in at the fitness center on campus.		Take an evening stroll, and check out the stars. Get in those steps!
Week 5	Choose the stairs!		Fruit salad makes a great snack!	If you are going holiday shopping, don't forget your pedometer!		

Table 3
Description of Treatment and Control Groups by Gender

Demographic variable	Male			Female		
	Treatment *N* (%) or *M* ± *SD*	Control *N* (%) or *M* ± *SD*	*p*[a]	Treatment *N* (%) or *M* ± *SD*	Control *N* (%) or *M* ± *SD*	*p*[a]
Age (months)	253 ± 44	260 ± 51	.574	249 ± 38	246 ± 38	.687
Race/Ethnicity						
Hispanic	24 (67)	20 (57)		41 (63)	43 (68)	
White	3 (8)	13 (37)		12 (19)	13 (21)	
Other	9 (25)	2 (6)	.004	12 (19)	7 (11)	.503
Weight (lb)	164 ± 31	174 ± 36	.208	141 ± 30	142 ± 24	.826
Height (in.)	72 ± 18	72 ± 16	.927	65 ± 11	64 ± 4	.242
Waist (in.)	32 ± 5	34 ± 5	.140	30 ± 5	30 ± 4	.479
Skinfold	26 ± 13	28 ± 12	.513	41 ± 15	40 ± 12	.587
BMI	24 ± 6	25 ± 6	.291	24 ± 5	25 ± 5	.236

[a]Chi square or independent samples *t* test.

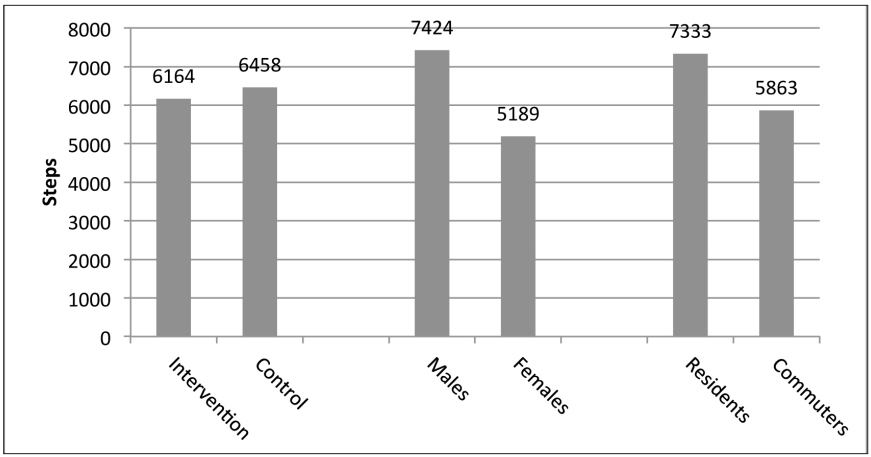

Figure 1. Mean daily steps per student within three categories. Mean daily steps per student were 6,164 and 6,458 for the intervention and control groups, respectively. The intervention and control groups did not differ significantly in physical activity as measured by number of steps (p = .467). However, males had 7,424 mean steps per day compared to females with 5,189 (p < .001), and resident students had 7,333 mean steps per day compared to commuter students with 5,863 (p = .001).

Pre- to post-change in physiologic measures (weight, BMI) did not differ between the intervention and control groups. Weight change among all students was minimal; the mean weight change per student was .50 lb for the intervention group and .06 lb for the control group. Mean BMI change over 10 weeks was .05 for the intervention group and –.01 for the control group, reflecting almost no change in BMI for the participants over the course of the study. Student age correlated negatively with pre- to post-change in weight (p = .003) and BMI (p = .013); older students had lower increases in weight and BMI during the study.

Multivariate analyses yielded similar findings. PA did not differ between students who received text messages promoting activity and those who did not. However, males and residents were more physically active than females and commuter students. Furthermore, weight and BMI changes were insignificant.

Discussion

The use of pedometers and enrollment in the wellness course were potential confounding variables in this study. Previous research has suggested that pedometer use stimulates ambulation (Bravata et al., 2007; Jackson & Howton, 2008). Furthermore, the U.S. Department of Health and Human Services (2011) suggested that pedometers are a useful tool in assisting individuals in meeting their daily PA goals (although they establish no national pedometer guidelines). Also, Jackson and Howton (2008) found that pedometers incorporated into class participation requirements positively influenced weight loss. This finding may be especially relevant to this study as the purpose of the university's wellness course is to stimulate PA and encourage other healthy behaviors through using pedometers and other methods.

Though this study failed to establish a causal link between the intervention (periodic text messaging) and increased PA, participants in neither the control group nor the intervention group experienced appreciable weight gain. This finding is consistent with the work of Richardson et al. (2008), suggesting that using a pedometer combined with enrollment in the wellness course may have served as cues to increase PA and contributed to the lack of weight gain.

Another interesting finding in this study is related to the mean steps per day achieved by both groups. The *Shape Up America* (2011) goal specifies 10,000 steps per day, which may be difficult to achieve. Participants in this study averaged fewer than 6,500 steps per day, yet experienced no appreciable weight gain. This finding suggests that college students may maintain weight on 6,000 to 7,000 steps per day. Therefore, establishing a goal of 8,000 steps per day may be more achievable and perhaps lead to weight loss.

Additionally, although the study population did not achieve generally accepted guidelines for steps per day, a statistically significant difference in the number of steps taken per day was observed in certain demographics. Specifically, in this study, a statistically significant difference was found between students who commuted to campus and those who resided on campus in the number of steps taken per day. Students living on campus took on average of 1,370 more steps per day than commuter students. This finding may provide further insight into the level of PA of college students, suggesting that the decision to reside on campus may influence behavior related to PA positively.

A finding more consistent with previous research relates to the number of steps taken based on gender. This study found that male participants had a higher number of steps per day (7,424) than female participants (5,189). This finding supports previous research, but again no appreciable weight gain occurred in this study population, which included males and females.

Finally, as noted previously, text messaging is a common and extensive practice among modern-day youth (Lenhart et al., 2010; Lopez & Livingston, 2010). As such, using standard text messaging may not be an effective method of conveying health promotion messages to youth. This may account for the findings of this study. Specifically, the text messages sent in this study may not have inspired the participants, or the respondents may have ignored promotional text messages in general. Notwithstanding these concerns, the capabilities of the ubiquitous mobile phone including animated messages, video recordings, and Internet access may offer effective methods of conveying health promotion messages. Future studies should use qualitative strategies, including focus groups, surveys, and interviews, to deepen understanding of student reactions to text messaging and to identify the messaging most effective in communicating with youth.

Care should be exercised when generalizing the findings from this study to different settings and populations. Findings from the study may not apply to students who are not enrolled in a wellness course and who do not wear pedometers. Although the statistical analyst was blinded to the treatments in this randomized controlled experiment, participants were not blind to treatment. No statistically significant differences were found between students who completed the study and students who did not on any of the demographic or physiologic measures. Although fewer participants completed the study than anticipated, over 50 subjects were in each group. Future research warrants a larger sample size. Finally, due to attrition, statistical power was reduced.

This study explored the effectiveness of an intervention strategy for influencing PA behavior in college students. Specifically, using text messaging was assessed to see whether students could achieve specific changes in PA. Although the findings did not support using text messaging as an effective method to increase PA, no appreciable weight gain or loss was noted between the study group and the control group. Furthermore, the study identified a difference in steps taken by study subjects who resided on campus versus those

who were commuters. These findings may have implications for university administration, wellness education, and health promotion research and warrants further investigation.

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