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A Pilot Study Examining Exercise Self-Efficacy as a Mediator for Walking Behavior in College-Age Women

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Since mechanisms of behavior change are not always evaluated in physical activity interventions, current interventions are limited until these mechanisms are better understood (Bauman, Sallis, Dzewaltowski, & Owen, 2002). Therefore, studies are needed that examine mediating variables, derived from theory, in the design, implementation, and evaluation of interventions. A mediator is a variable that must be included in an intervention in order for a specific change in a dependent variable or outcome to occur (MacKinnon, 2008). MacKinnon (2008) describes several methods of identifying mediators using statistical procedures, including the causal inference approach, difference in coefficients, product of coefficients, structural equation modeling and bootstrap estimates of the mediated effect.

Using different statistical methods to determine mediation effects can make it difficult to compare studies on this topic. A method described by Baron and Kenny (1986) was used to examine the mediating effect of self-efficacy on physical activity behavior in some studies (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002; Miller, Trost, & Brown, 2002; Hallam & Petosa, 2004; Fahrenwald, Atwood, & Johnson, 2005; Lewis, Forsyth, Pinto, Bock, Roberts, & Marcus, 2006; Bray, 2007) while other models of mediation analysis were used in additional studies (Elbel, Aldana, Bloswick, & Lyon, 2003; Dishman, Motl, Saunders, Felton, Ward & Dowda, 2004; Dishman, Motl, Sallis, Dunn, Birnbaum, & Welk, 2005; Fahrenwald et al., 2005; Lewis et al., 2006; Robbins, et al., 2006).

Of the mediators that have been studied, self-efficacy has shown mixed results in that it mediated physical activity in some studies (Dishman et al., 2005) but did not mediate physical activity in other studies (Elbel et al., 2003; Hallam & Petosa, 2004; Dishman et al., 2005; Fahrenwald et al., 2005; Lewis et al., 2006; Robbins, Gretebeck, Kazanis, & Pender, 2006).

Given that these results are equivocal, there is a need to study this issue in additional populations and settings. Other possible explanations for these results were that the intervention was not specifically designed to create changes in self-efficacy, thus behavior did not concurrently change or it changed through another mechanism; or power was limited due to small sample sizes. It is also possible that baseline self-efficacy may influence whether or not it acts as a mediator. In other words, if a participant starts with high self-efficacy, it is possible that an intervention may not facilitate further improvement, which may result in a failure of self-efficacy to act as a mediator.

Bootstrapping is a nonparametric method used to estimate standard errors by resampling from a sample (Vogt, 2005). Preacher and Hayes (2004) state several reasons why bootstrapping is superior to other methods used in determining mediation. First, compared to bootstrapping, the Baron & Kenny (1986) procedure is limited by low statistical power and it does not address the significance of the indirect effect. Sobel's test, which is more accurate than Baron and Kenny (1986), also has low statistical power but it assumes the indirect effect to be normally distributed over repeated sampling. In contrast, bootstrapping assumes that the distribution of the indirect effect

approximates that of the population while it avoids making the assumption that it is distributed normally and can be used on sample sizes as small as 10 (Preacher & Hayes, 2004). To date, despite the fact that physical activity data are typically non-normally distributed, there are no studies that examine mediation variables in physical activity interventions using the bootstrapping method.

This study was conducted in conjunction with an IRB approved quasi-experimental design that used a web-based intervention to deliver a physical activity promotion program. The behavioral outcomes for this study (e.g., increased walking behavior) have been reported elsewhere[1]. This paper presents the results of testing for a mediation effect between the intervention and participant's Exercise Self-Efficacy level. It was hypothesized that increased exercise self-efficacy, as measured by the Exercise Self-Efficacy Scale, would mediate walking behavior, as measured with a pedometer, in college-age women participating in a 4-week web-based physical activity program.

METHOD

Design

The design was a pretest, posttest quasi-experimental design with two groups, web-based intervention and control. The independent variable was the physical activity intervention. The dependent variable was walking behavior. The mediator variable was Exercise Self-Efficacy score.

Participants

Participants were recruited from the female population of a college campus in the Southwest. A full description of participant recruitment and inclusion criteria have been reported elsewhere[1]. Although 210 college-age women expressed interest in participating and met the eligibility criteria for the sample, 121 women formally enrolled in the study (58% participation rate). For the purposes of this study, only the data from participants who completed the study were used (Intervention group = 22; Control group = 59) (67% completion rate).

Of the women who did not complete the study, 2 students were in the control group and 38 students were in the intervention group (33% attrition rate). Analysis of those who were removed from the study due to low participation rates (but who provided consent) revealed they were no different from those retained in the sample. The samples were not statistically different from one another in regard to age ($t(58)=.235$, $p=.815$), walking behavior at baseline ($t(58)=.266$, $p=.791$), exercise Self-efficacy at baseline $t(58)=-1.22$, $p=.255$), year in school ($\chi^2=2.83$, $p=.417$) or academic major ($\chi^2=3.58$, $p=.733$).

Pretest Self-Efficacy scores for the intervention group had a mean of 6.10 (1.7). Pretest Self-Efficacy scores for the control group had a mean of 5.60 (1.5).

Measure

The Exercise Self-Efficacy Scale (Hallam, 1994) - The Exercise Self-Efficacy scale was used to measure the perceived confidence one has to overcome barriers to exercise. Hallam (1994) revised an instrument developed by Garcia and King (1991) to improve the instrument's ability to detect the strength component of Self-Efficacy. The format of the instrument was modified to make it more user-friendly and readable for participants. A full description of the questionnaire revisions and the pilot testing is reported elsewhere (Ornes, Ransdell, & Pett, 2006).

Participants were asked to rate, on a scale of 0 to 10 (0 being least confident and 10 being very confident), how confident they were that they would exercise under a variety of situations. Responses to the items were summed and divided by the number of items completed to provide a mean exercise self-efficacy score. The possible range of scores was 0 to 10. Higher scores meant the participant exhibited a higher exercise self-efficacy. For this study, Cronbach's test of internal consistency was $\alpha=.90$.

[1] Ornes, L., & Ransdell, L. B. (2007) Web-based physical activity intervention for college women. *International Electronic Journal of Health Education, 10,* 126-137. Retrieved on September 10, 2007 from http://www.aahperd.org/aahe/publications/iejhe/upload/07_L_Ornes-2.pdf

Procedure

A full description of the intervention and how data were obtained (pedometer step counts, used as the dependent variable) has been reported elsewhere[1]. At the beginning and end of the intervention, all participants met with the researcher and completed the Exercise Self-Efficacy Scale.

Analysis of Data

Statistical analyses were conducted using SPSS (version 17.0) and level of significance was set at alpha >.05. Given the small sample size, this pilot study followed steps for mediation analysis using nonparametric bootstrapping to assess the indirect effects and determine confidence intervals (Preacher & Hayes, 2004). The SPSS syntax developed by Preacher and Hayes (2004) estimates the total, direct, and indirect effects of the causal variable (intervention) on the outcome variable (walking behavior) through the mediator variable (exercise self-efficacy).

RESULTS

There was no difference in the exercise self-efficacy scores between the control and intervention group at the beginning of the intervention, $t(79) = 1.27$, $p=.21$. At the end of the intervention, the mean exercise self-efficacy scores of the control group were less (M=5.44, SD=1.6) and the scores of the intervention group were more (M= 6.49, SD=1.7) than scores taken at the beginning of the intervention. There was a significant difference in the Self-Efficacy scores between the women in the intervention group compared to women in the control group, $F(1,79)=4.63$, $p=.034$.

To determine whether exercise self-efficacy mediated the relationship between the intervention and walking behavior, bootstrapping analyses were conducted using methods described by Preacher and Hayes (2004) for estimating direct and indirect effects with simple mediation. The results are based on 5000 bootstrap resamples from a beginning sample of 81.

The dependent variable was the walking behavior computed as difference scores (i.e., mean steps at postintervention minus mean steps at preintervention). The independent variable was the group assignment, intervention or control. The mediating variable was Exercise Self-Efficacy, also computed as difference scores (i.e., mean scores at posttest minus mean scores at pretest). These variables were entered into the SPSS macro created by Preacher and Hayes (2004) for bootstrap analyses for simple mediation.

The bootstrapping (n=81, bootstrapping 5000) results revealed that the point estimate of the total indirect effect on the outcome variable was -86.68. Since zero is in the 95% Confidence Interval (-617.45 to 145.44), we can conclude that it is not significantly different from zero at p >.05 (two tailed). This means that changes in self-efficacy as a result of the intervention did not act as mediators to walking behavior.

A multivariate analysis of variance (MANOVA) was conducted to evaluate if there was a relationship between completion of assignments in the intervention and a change in the exercise self-efficacy and physical activity scores. The independent variable, completion of all assignments, included two levels: completion, and non-completion. The dependent variables were change in the Self-Efficacy scores and physical activity scores. There were no significant differences between results of those who completed the assignments compared to those who did not, Wilks' $\lambda=.958$, $F(2,50)=1.095$, $p=.342$.

DISCUSSION

In this pilot study, we examined whether exercise self-efficacy mediated walking behavior. Although participants in the study experienced an increase in pedometer step counts, exercise self-efficacy did not mediate the increase in walking. These findings are unique in that we used bootstrapping as a mediator analysis technique—which adds to the literature since physical activity data are typically non-normally distributed. It should also be mentioned that these findings point to the need to continue to examine other potential mediators for walking as exercise in college-aged women.

Despite our novel analysis and findings for this pilot study, several limitations are worth mentioning. Participants in this study volunteered and were predominantly Euro-American. Thus, study results cannot be generalized to other populations. Future researchers should examine more diverse groups.

Second, several participants never engaged in the intervention and were dropped from the study. Researchers should find ways to encourage participants to log onto the website and make it more interactive so as to engage them more thoroughly (Ransdell, Dinger, White, & Miller, 2009). For example, researchers could assign "homework" that must be completed and emailed to the researcher after each module is viewed. That may be one way to encourage college women to view the content at least once.

Third, there was no attention control group that required students to participate in another web-based intervention unrelated to walking behavior. The inclusion of an attention control group could have helped rule out the possibility of students showing improvement in their walking behavior because it was being observed (i.e., Hawthorne effect).

Fourth, exercise self-efficacy did not mediate walking behavior in this sample of women. This result is similar to that of Fahrenwald and colleagues (2005) who found that an increase in physical activity behavior was not associated with an increase in self-efficacy. Furthermore, no mediation occurred. It is possible that self-efficacy is not a mediator for women to change their health behavior. Since research on mechanisms or mediators of behavior change is relatively scarce, further studies on other possible mediators of health behavior change (e.g., self-monitoring, positive self-talk, etc.) are needed.

Fifth, while statistical methods that do not lack power, such as the bootstrapping method used for this study, should be used, they cannot make up for sampling problems or weak interventions. Before assumptions are made about the mediation effect, the research methods should be reviewed to strengthen the design.

To our knowledge, this is the first study to examine whether a web-based intervention can increase walking behavior in college-age women via the mediating effects of exercise self-efficacy. Despite the limitations, this study used updated statistical techniques to examine a potentially important mediator in physical activity research. Second, the intervention was aimed at increasing self efficacy rather than walking behavior and third, the sample was college-aged women who have been identified as at risk for sedentary behavior. However, exercise self-efficacy does not seem to be a mediator for this behavior in this sample. Further studies examining the mediators of walking behavior and health behavior change are needed.

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