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PM536

Promoting Physical Activity through Individual Motivation

Introduction

In the United States, only 53.3% of adults met the Physical Activity Guidelines for the recommended amount of aerobic physical activity (CDC, 2021). Current guidelines state that adults should engage in at least 150-300 minutes a week of moderate-intensity aerobic physical activity that is distributed throughout the week (U.S. Dept. of Health and Human Services, 2018). These recommendations vary based on age and other health factors that could affect someone's ability to incorporate physical activity in their daily routines; some of these non-age-related factors include whether someone has a chronic health condition or disability (U.S. Dept. of Health and Human Services, 2018). Even among other demographic factors, however, there are differences in the level of physical activity. For example, although both men and women have shown upward trends in the prevalence of walking, women are less likely to have enough physical activity to meet specified guidelines compared to men (Ussery et al., 2017). There is also greater inactivity among those with a chronic condition, lower educational attainment, Hispanics, and non-Hispanic Blacks (CDC, 2021). Given the differences in physical activity between populations of varying backgrounds, there may be a need to tailor interventions so they can address individual concerns regarding exercise and regular physical activity.

Furthermore, with the obesity rate at the highest percentage ever recorded, it is important to encourage increased physical activity and healthier eating habits for all people living in the United States (Trust for America's Health, 2020). There are many forms of physical activity that could be used to meet the Physical Activity Guidelines for Americans, most of which have

varying levels of intensity. For many individuals, walking can be an easy form of physical activity that can be monitored routinely through their existing smartphone devices (Ussery et al., 2017). Although there may be environmental factors impacting whether someone is able to walk regularly through their neighborhood, theories have demonstrated the importance of addressing constructs more closely tied to the individual that may also contribute to positive behavior change when it comes to physical activity. The Centers for Disease Control and Prevention (CDC) has recommended every person to be active with peers and to incorporate it into someone's daily routine, indicating how social norms and personal beliefs affect an individual's decision to be physically active (2021).

One such theory is the Theory of Planned Behavior (TPB) that encompasses several constructs influencing an individual's intention to engage in the behavior of interest that therefore influences whether the individual ultimately performs the behavior of interest or not (Valente, 2002). The constructs addressed through the TPB include behavioral beliefs, attitude toward the behavior, normative beliefs, subjective norm, control beliefs, and perceived behavioral control. The proposed intervention, consisting of a motivational script and educational information, utilized in this study addresses these constructs with the intent to improve overall self-efficacy and increase the likelihood that a participant will believe they are able to integrate physical activity into their daily lives. Some positive behavioral and normative beliefs targeted through the intervention are related to the participant's belief that regular physical activity is both beneficial to their health and is also socially accepted by others around them. The motivational script also attempts to create a positive attitude toward the behavior by presenting physical activity as something beneficial and not overly difficult. Through the scripted conversation, the researcher is touching on elements that can empower the participant

and lead them to believe that they have control over how physical activity is introduced into their daily routine. According to the TPB, this type of approach should increase the participant's intention to engage in physical activity and thereby increase the likelihood that the desired behavior will be achieved.

Materials and Methods

Intervention Protocol and Study Measures

Study participants were recruited by Master of Public Health students enrolled in PM536 at the University of Southern California, with each person in the class recruiting ten potential participants for a total of 360 possible study participants. To maintain anonymity and confidentiality, participants were assigned a unique ID number provided to them in the order of recruitment. Those with an even-numbered ID were placed in the intervention group and those with an odd-numbered ID were placed in the control group. As participants were recruited and assigned their respective ID number, verbal consent was obtained, and each person was provided with an overview of the intervention. Additionally, potential participants were asked if there were any physical ailments or conditions that would prevent them from engaging in moderate physical activity such as walking; if the individual answered yes, they were not enrolled in the study. Students continued to recruit participants until they had enrolled ten participants or until the previously set date deadline was reached, whichever came first. This resulted in the successful recruitment of 241 participants with 119 assigned to the control group and 122 assigned to the intervention group.

Once all participants were enrolled and verbal consent was obtained, students detailed the process of collecting step count data. This was done through a variety of mobile applications, depending on the participant's smartphone operating system (Android vs. iOS). There was no

single mobile app used across all participants to track steps and distance walked/traveled. Before administering the questionnaire, students asked participants to carry their smartphone device with them as much as possible for seven days to increase the accuracy of the step count data collected. Although steps were tracked through the mobile apps, students did not have access to every participant's smartphone data and therefore relied on participants to self-report their steps and distance.

After an appropriate step count app was identified, each participant was asked a series of baseline questions verbally or through an online survey platform. This initial survey captured information on the following demographic and geographic variables: age (in years), sex (male, female, or transgender), race/ethnicity (Latino/Hispanic, African American, White, Asian/Pacific Islander, Native American, or Other – specify), marital status (single, not married but living with a partner, married, separated, divorced, or widowed), whether there are dependent children under the age of 18 in the household (yes or no), years of education completed, employment status (check all that apply – employed full-time, employed part-time, caregiver, looking for work, student, disabled, and/or retired), hours spent working each week, hours spent caregiving for dependents each week, zip code, height (in feet and inches), weight (in pounds), and whether they have high blood pressure (yes or no), high cholesterol (yes or no), and/or diabetes (yes or no). These were treated as potential covariates in the analysis, with the intervention assignment serving as the main independent variable. The baseline survey also assessed the participant's current level of physical activity and current health knowledge. A measure of pre-intervention steps was collected at the conclusion of the baseline survey as well for participants that had that data available to share with the student; not all participants were actively using a step tracking application prior to the study and therefore could not provide pre-intervention data.

Participants assigned to the intervention group were then read a script that included educational information as well as questions aimed at addressing motivation, barriers to physical activity, and facilitators of physical activity. These participants were given information on the definition of physical activity and what the recommendations for adults consist of. Motivational questions included: *What benefits, if any, do you see of exercising more regularly?* and *What are some reasons you have for living a healthier life?*. Scenarios were discussed that provided solutions to commonly perceived barriers to physical activity and suggestions were shared that encouraged looking towards their peers or children as support systems for incorporating physical activity into their daily routine. Participants in the control group were not provided with the motivational script or any additional information after the baseline survey. Both groups were then followed up with after seven days.

The follow-up survey was administered to all participants regardless of whether they were in the intervention or control group. Questions in this survey reassessed their level of physical activity and health knowledge using parallel questions to those included in the baseline survey. Students then asked participants to self-report their step counts and distance data from the previous seven days using the same app from which baseline data was gathered. The change in steps between the baseline and follow-up survey served as the main dependent variable of interest. Each student shared the data collected from their participants so it could be compiled into one dataset that merged all survey responses for all participants enrolled in the study; incomplete survey responses were reported initially and only removed if needed for the appropriate statistical analysis. This final step concluded the intervention protocol that each student was asked to follow throughout the study period.

Statistical Methods

Descriptive statistics, such as means, frequencies, standard deviations, etc., were assessed for all variables on which data was collected. This was done prior to recoding any variables to determine whether it was necessary or advisable to change any continuous variables to be categorical. The descriptive statistics also guided any decisions that were made regarding if incomplete responses would be included in the final statistical analyses. Ultimately, all continuous variables were recoded to categorical variables after exploratory data analysis to account for data that covered a wide range of values. Participant characteristics are shown in Table 1 with the categories defined for each of the recoded variables. Any values entered that fell outside the range of possible responses were coded to missing. Frequencies and percentages are shown separately for those in the control group and those in the intervention group, with totals presented as reference. The change in steps was calculated by subtracting the step count collected at baseline from the step count collected in the follow-up survey. The change in steps was also recoded to be a binary variable (more steps vs. fewer steps between baseline and follow-up) for the purposes of testing associations.

After all the transformations were completed and variables were recoded, bivariate analyses were conducted using a series of Chi-square tests to determine the association between the change in steps (more vs. fewer) and all possible covariates and the main independent variable – whether the individual was placed in the control or intervention group. None of the bivariate tests yielded statistically significant results at an $\alpha = 0.05$. Therefore, rather than potentially overfitting a multivariate logistic regression model with covariates that would not significantly improve the fit of the model, an independent samples t-Test was conducted to assess whether there was a statistically significant change in the mean difference in step counts at baseline vs. follow-up. For this analysis, the dependent variable was left in its continuous form

(follow-up steps – baseline steps). The normality assumption for this statistical test was met due to the relatively large sample size and Levene's Test for Equality of Variances was non-significant, for which reason equal variances were assumed. All statistical analyses were conducted using SPSS.

Results

Across both the control and intervention groups, participant characteristics appeared comparable with no major significant differences between the two groups. The control group was slightly younger than the intervention group with 57.1% being 30 years of age or less while the intervention group had 50.8% of individuals being 30 years old or less. In general, across both groups, there were more female participants than male participants (58.3% vs. 41.7%) and the majority had some form of secondary education (53.9% had a bachelor's degree). Most participants were single (51.7%) and had no dependent children in their household (80.9%). In general, participants were also healthy when it came to the three health factors that were measured: high blood pressure, high cholesterol, and diabetes. Those enrolled tended to be full-time employees that did not seem to have a strong familial unit, as determined by marital status and whether there were children. Full descriptive statistics, including counts and percentages, for demographic variables are shown in Table 1.

Table 1: Participant Characteristics

Variable	Control Group N = 119	Intervention Group N = 122	Total N = 241
Age			
Less than 18 years old	1 (0.8%)	0	1 (0.4%)
18-30 years old	67 (56.3%)	62 (50.8%)	129 (53.5%)

31-50 years old	27 (22.7%)	46 (37.7%)	73 (30.3%)
51-64 years old	19 (16.0%)	7 (5.7%)	26 (10.8%)
65+ years old	5 (4.2%)	7 (5.7%)	12 (5.0%)
Sex			
Male	55 (46.2%)	45 (37.2%)	100 (41.7%)
Female	64 (53.8%)	76 (62.8%)	140 (58.3%)
Education			
Less than high school	2 (1.7%)	4 (3.3%)	6 (2.5%)
High School	21 (17.6%)	14 (11.5%)	35 (14.5%)
Bachelor's	63 (52.9%)	67 (54.9%)	130 (53.9%)
More than Bachelor's	33 (27.7%)	37 (30.3%)	70 (29.0%)
Hours Worked			
No hours worked	14 (11.9%)	19 (15.7%)	33 (13.8%)
Full-time (40 hours)	45 (38.1%)	44 (36.4%)	89 (37.2%)
More than full-time (40+ hrs)	29 (24.6%)	23 (19.0%)	52 (21.8%)
Less than full-time (< 40 hrs)	30 (25.4%)	35 (28.9%)	65 (27.2%)
Hours Caregiving			
No hours caregiving	82 (73.2%)	76 (66.1%)	158 (69.6%)
1-40 hours caregiving	23 (20.5%)	28 (24.3%)	51 (22.5%)
41+ hours caregiving	7 (6.3%)	11 (9.6%)	18 (7.9%)
Weight (in lbs)			
130 lbs or less	24 (20.2%)	28 (23.0%)	52 (21.6%)
131-150 lbs	30 (25.2%)	26 (21.3%)	56 (23.2%)

151-170 lbs	22 (18.5%)	26 (21.3%)	48 (19.9%)
171-200 lbs	21 (17.6%)	29 (23.8%)	50 (20.7%)
201+ lbs	22 (18.5%)	13 (10.7%)	35 (14.5%)
Height			
Less than 5ft tall	5 (4.2%)	2 (1.6%)	7 (2.9%)
At least 5ft tall	103 (86.6%)	110 (90.2%)	213 (88.4%)
6ft or taller	11 (9.2%)	10 (8.2%)	21 (8.7%)
Marital Status			
Single	55 (46.2%)	69 (57.0%)	124 (51.7%)
Not married but living w/ partner	11 (9.2%)	9 (7.4%)	20 (8.3%)
Married	51 (42.9%)	39 (32.2%)	90 (37.5%)
Divorced	1 (0.8%)	4 (3.3%)	5 (2.1%)
Widowed	1 (0.8%)	0	1 (0.4%)
Race/Ethnicity			
Latino	25 (21.2%)	18 (14.9%)	43 (18.0%)
African American	6 (5.1%)	6 (5.0%)	12 (5.0%)
White	50 (42.4%)	55 (45.5%)	105 (43.9%)
Asian/Pacific Islander	36 (30.5%)	39 (32.2%)	75 (31.4%)
Native American	0	1 (0.8%)	1 (0.4%)
Other	1 (0.8%)	2 (1.7%)	3 (1.3%)
Dependent children in the household			
No	99 (85.3%)	91 (76.5%)	190 (80.9%)
Yes	17 (14.7%)	28 (23.5%)	45 (19.1%)

Employment Status			
Employed, full-time	75 (63.0%)	75 (62.0%)	150 (62.5%)
Employed, part-time	16 (13.4%)	17 (14.0%)	33 (13.8%)
Caregiver	3 (2.5%)	3 (2.5%)	6 (2.5%)
Looking for work	2 (1.7%)	3 (2.5%)	5 (2.1%)
Student	18 (15.1%)	16 (13.2%)	34 (14.2%)
Retired	5 (4.2%)	7 (5.8%)	12 (5.0%)
High blood pressure			
No	109 (91.6%)	108 (88.5%)	217 (90.0%)
Yes	10 (8.4%)	14 (11.5%)	24 (10.0%)
High cholesterol			
No	105 (88.2%)	108 (88.5%)	213 (88.4%)
Yes	14 (11.8%)	14 (11.5%)	28 (11.6%)
Diabetes			
No	116 (97.5%)	120 (98.4%)	236 (97.9%)
Yes	3 (2.5%)	2 (1.6%)	5 (2.1%)

The independent samples t-Test was conducted to compare the mean change in steps between the intervention (n = 113) and control groups (n = 111). Both groups had positive values for the mean change in steps, indicating that participants in both had increased their step count from baseline to follow-up. Those in the control group had recorded an average of 852.92 more steps at follow-up compared to their baseline amount, while those in the intervention group reported an average of 3,080.67 more steps at follow-up (Table 2). The standard deviations for

both groups were large (> 12,000 more steps for both), demonstrating the wide range of step count values recorded by participants. Assuming normality and independence between participants in the control and intervention groups, there was no statistically significant difference in the mean change in steps between both groups ($p = 0.183$). The difference in the mean change in steps between those in the intervention and control groups could therefore potentially be explained by chance at an $\alpha = 0.05$ and may not be a result of the intervention.

Table 2: Independent Samples t-Test Comparing the Mean Change in Steps (Post – Pre) Between the Intervention and Control Groups

Variable	Control		Intervention	
	N	Mean (Std. Dev.)	N	Mean (Std. Dev.)
Change in Steps (Post – Pre)	111	852.92 (12461.78)	113	3080.67 (12483.36)
				p-value = 0.183

Discussion

The lack of statistically significant results indicates that the proposed intervention may not be successful at increasing physical activity among people of similar demographic characteristics as those included in the study. Given the relatively large sample size, these results may be generalizable to a wider range of individuals as well. Since bivariate analyses did not show any statistically significant associations between the change in steps and other covariates as well, it may be important to go beyond individual characteristics to promote behavior change when it comes to physical activity. While the intervention addressed most of the constructs of the Theory of Planned Behavior, the results of the statistical analysis would reason that those constructs are not sufficient in bringing about the desired behavior (Valente, 2002). Since few

variables were collected with regards to the built environment, it cannot be fully ascertained whether that has more of an impact on physical activity than the measures that were collected.

Although the intervention was tailored to fit the TPB, the characteristics of the participants (most single with no dependent children) could signal to the Social Learning Theory instead as a reason for why the intervention failed in increasing physical activity among the participants (Valente, 2002). Those enrolled in the study did not appear to have sufficiently strong social networks that could have supported their behavior change. While the motivational script did include some points about how peers could be a part of incorporating physical activity into their daily routines, it did not address how to establish social connections to be able to do so if a participant did not have any readily available. Therefore, discussing this construct through the intervention would not have changed the fact that many participants may not have had a strong enough influence in their life on which to model the desired behavior. Without a reliable role model, the Social Learning Theory predicts that the individual would have a difficult time changing their behavior as was demonstrated through the study results.

Limitations

Some key limitations in the study consist of potential errors in self-reported data and differences in the implementation of the intervention protocol that may have affected results. While all students used the same intervention protocol for their recruited subjects, the format in which questionnaires were presented could vary as could the tone and manner in which the student approached the intervention. These small variations multiplied across all students in the class may have had some impact on the final merged data set. Furthermore, since all data was self-reported and some required participants to recall details about their physical activity, there may be some information bias. Additionally, participants potentially used different step tracking

apps that could have therefore resulted in varying levels of accuracy in capturing that information. Without a consistent tool to measure steps, it is uncertain whether the data collected was fully accurate or how much this inconsistency skewed the data. These errors in data collection could have some impact on how findings were calculated and interpreted afterwards.

Statistically, some limitations included non-responses that lowered the sample size and the potential effects of confounders. Of the 241 participants recruited, only 224 were included in the statistical analysis due to missing data or incomplete responses. The power to detect a difference in the mean change in steps decreases as the sample size decreases, so poor response rates could have affected the level of statistical significance observed. Also, although bivariate analyses did not show statistically significant associations between the covariates and the change in steps, the potential effects of confounders cannot be discounted as there may be other unknown and unmeasured variables at play. The analysis conducted to assess the impact of the intervention should be considered preliminary and requires additional data and statistical tests to fully measure the influence of the intervention on the participants' behavior change or lack thereof.

Recommendations

To improve the intervention and quality of data collected, there are some changes that could be incorporated for future studies. Investigators should consider identifying a single tool with which to record step counts, whether that be the same app for all participants or leasing smartwatches to participants that could improve the accuracy consistently across all recruited subjects. Additionally, data collection and the implementation of the intervention should be limited to a few trained data collectors rather than having all students in a moderately sized class have some role in this. By limiting the number of data collectors, there would be an increased

likelihood that the intervention would be conducted comparably across participants. Students could still engage in the recruitment efforts but would have the data collector speak directly to the participant for both surveys and the intervention. Randomization of participants to the intervention group could also be improved such that it is not dependent on the order in which participants were recruited.

To improve the statistical analysis, it may be helpful to oversample in a future study to improve the overall power. Capturing more data on different measures that could address other theory constructs may also assist in providing a more complete picture with regards to the impact of the intervention and how people may respond differently. Since there is some indication that the Social Learning Theory may also be appropriate for the type of behavior change that is being sought, future studies could gather additional data that would give investigators a better understanding of how social networks are important when it comes to increasing physical activity. For both theories referenced, however, it would also be beneficial to have multiple points of follow-up rather than just one. Given that participants in both groups increased their step counts over the one week, it might be that just enrolling in this type of study made participants more aware of the physical activity they were engaging in; this could have been a contributing factor to the results that were observed. With longer and more follow-up, it may allow investigators to see if the intervention was having any true effect on physical activity.

Conclusion

Overall, the intervention consisting of a motivational script and health education did not appear sufficient to motivate individuals to engage in more physical activity after a one-week period. Participants in the intervention and control groups were similar across demographics and both had increased step counts at follow-up. However, the difference between the two groups did

not reach statistical significance and could potentially indicate that the approach taken by this intervention should be altered in future public health programming that seeks to increase physical activity. Addressing the individual's beliefs, attitudes, and knowledge did not produce the desired effect on behavior change, which allows future researchers to begin looking towards other potentially contributing factors that are more influential over someone's behavior as it pertains to physical activity. With the obesity crisis only worsening during the COVID-19 pandemic, studies such as this one are instrumental in identifying best practices to motivate people of diverse backgrounds to exercise more routinely (Trust for America's Health, 2020). Although results did not show that the intervention was effective, they did provide additional information that can help guide future studies around public health strategies to increase physical activity.

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