Published in final edited form as:

J Phys Act Health. 2017 July ; 14(7): 513–519. doi:10.1123/jpah.2016-0515.

Psychosocial Predictors of Physical Activity Change among College Students in an Obesity Prevention Trial

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Abstract

Background: Moderate-to-vigorous physical activity (MVPA) is critical for maintaining a healthy weight, although little is known about psychological barriers to maintaining MVPA in at-risk groups. Identifying characteristics associated with poor MVPA maintenance in obesity prevention programs could improve participant outcomes.

Methods: Toward this end, we examined predictors of MVPA in an obesity prevention trial for college students at risk for weight gain ($n = 333$; 72% female, $M_{BMI} = 23.4 \text{ kg/m}^2$). Participants engaged in one of three weight control interventions and in four assessments over 12-month follow-up (i.e., measured height/weight, self-reports of psychosocial characteristics, four days of accelerometer wear).

Results: Multilevel modeling analyses showed that across conditions, participants decreased total MVPA minutes per week over 12 months ($B = -5.48$, $p < 0.01$). Baseline self-report scores for both impulsiveness and cognitive dissonance regarding engaging in unhealthy behaviors negatively predicted MVPA over time. Participants higher (vs. lower) in baseline impulsiveness ($B = -6.89$, $p = 0.03$) and dissonance ($B = -4.10$, $p = 0.04$) began the study with more MVPA minutes, but showed sharper declines over time.

Conclusions: Targeted MVPA-focused intervention for students who show elevated impulsiveness and cognitive dissonance may improve both MVPA and weight control outcomes for these individuals.

Keywords

physical activity; obesity; health behavior; psychology; guidelines and recommendations

Accumulating evidence shows the importance of moderate-to-vigorous physical activity (MVPA) for maintaining a healthy body weight, particularly among those at risk for weight gain.^{1,2} College students with weight concerns represent one such group; they tend to gain weight and decrease physical activity during college,^{3,4} and those with weight concerns (e.g., history of dieting) are at greater risk for these two adverse health outcomes.^{5,6} As college obesity prevention programs involve multiple behavior changes, identifying participants who specifically are unlikely to maintain MVPA in this context could improve long-term weight control outcomes by identifying those who may need more intensive interventions.

College students cite lack of time, failure to create an effective schedule, and norms for physical inactivity as key obstacles to MVPA.^{3,7} Although these factors are modifiable, current prevention efforts focused on methods to change these circumstances (e.g., time management activities) has not reversed the trends of MVPA decreases or associated weight gain among college students. Little is known about psychosocial facilitators and barriers to MVPA in college students at risk for weight gain. For example, meta-analytic investigations of relations between personality characteristics and PA has shown modest positive associations with both extraversion and conscientiousness (which may facilitate MVPA; r s ~0.20), and a weak negative association with neuroticism (which may impede MVPA; r = -0.11).⁸ An important feature of such work is its reliance on cross-sectional methods, which cannot establish temporal precedence, and self-reported MVPA, which can be very inaccurate.⁹⁻¹¹ Thus, identifying novel psychosocial predictors of MVPA *change* in at-risk students should generate findings with greater utility for improving weight gain prevention efforts.

In order to engage in MVPA, individuals must overcome immediate environmental and internal pressures to conserve energy via sedentary activities and focus on longer-term gains (e.g., increased physical fitness, reduced risk for chronic illness).¹² Impulsiveness, or the tendency to respond to immediate reward (rather than on more valuable delayed reward), may derail MVPA by presenting immediate rewards for sedentary activities (e.g., low physical exertion).¹³⁻¹⁵ In contrast, cognitive dissonance (i.e., subjective distress) about engaging in unhealthy behaviors, as well as perceived sociocultural pressure to be thin, may promote MVPA. The desire to avoid cognitive dissonance raised by discrepancies between one's thoughts and behaviors has been shown to motivate healthy eating,^{16,17} as individuals may experience psychological discomfort from simultaneously knowing the importance of healthy eating and engaging in unhealthy eating. Few studies have examined the relation between dissonance and MVPA, however. Similarly, perceiving sociocultural pressure for thinness also has shown a positive relation with unhealthy eating behaviors¹⁸ and reported emphasis on physical activity for weight control.¹⁹ Perceptions of pressure rarely have been investigated with respect to objectively-assessed MVPA, and there has been little

investigation of impulsiveness, cognitive dissonance, or perceived sociocultural pressure as prospective predictors of MVPA *change* over time.

The present study uses data from a randomized obesity prevention trial, targeted toward college students at risk for weight gain, to identify psychosocial predictors of MVPA change over one year. Identifying predictors of MVPA maintenance, as well as predictors of decreases over time, would point to characteristics that may require targeted intervention in the context of obesity prevention. Predictors of interest were impulsiveness, cognitive dissonance regarding engaging in unhealthy behaviors, and perceived sociocultural pressure for thinness. We hypothesized that impulsiveness would predict decreases in MVPA, whereas cognitive dissonance regarding engaging in unhealthy behaviors and perceived pressure for thinness would predict increases in MVPA, over follow-up. Given evidence that young adult males engage in more physical activity than females,^{20,21} we also examined gender differences in MVPA change over time and whether gender moderated predictor effects. Consistent with existing evidence, we hypothesized that men would show more minutes of MVPA than women over time (i.e., a time-by-gender interaction effect). As there is little evidence to suggest interactions between gender and our predictors of interest, however, we did not expect moderating effects of gender on relations between psychosocial predictors and MVPA over time.

Method

Participants and Procedure

College students from three large, public universities ($n = 333$, 72% female) were recruited via print advertisements (flyers, brochures, direct mail). Institutional Review Boards at all three universities approved the study protocol; written informed consent was obtained by trained research staff prior to eligibility screening. Students were eligible if they self-reported concern about their weight, defined as: (1) agreeing/strongly agreeing with at least one of the following: “I would like to be thinner/have less body fat” and/or “I am worried about gaining weight/body fat,” and (2) affirming one of the following: “Have you experienced any weight gain within the past year?” and/or “Do you believe that there is room for improvement in your diet and exercise habits?” Students who met these criteria, who did not have an eating disorder (based on a diagnostic interview²²), and who had BMIs ≤ 30 were invited to enroll. The average participant was 19 years old ($SD = 2.00$) with a BMI of 23.4 kg/m^2 ($SD = 2.40$). The majority of participants were Caucasian (72%); the remainder identified as Asian/Pacific Islander (15%), Hispanic/Latino (11%), Black/African American (3%), Alaskan native (3%), and Hawaiian native (0.5%). Approximately 50% of the sample began the program as first-year students, with 36% who began in their second year (14% began as upperclassmen).

Upon enrollment, participants were randomly assigned to one of three intervention conditions: educational video (control), healthy weight skills, or cognitive dissonance enhancement. Participants in healthy weight skills and cognitive dissonance enhancement attended one-hour weekly group sessions, which occurred during the first six weeks of participation. Both of these interventions addressed unhealthy weight gain and disordered eating behaviors by recommending small sustainable improvements in eating and physical

activity, to bring intake into balance with output;¹⁶ in the cognitive dissonance enhancement condition, participants engaged in activities designed to create cognitive dissonance about engaging in unhealthy lifestyle behaviors. In the education condition, participants watched a one-hour educational video about the costs of obesity. A full description of the intervention conditions and their effect on weight control outcomes can be found in Stice et al.²³

Assessments took place at baseline, end-of-treatment (6 weeks later), and at 6- and 12-month follow-ups. Participants completed self-report measures of psychosocial experiences at baseline. The Barratt Impulsiveness Scale,²⁴ used to capture general impulsiveness, comprises 30 items (e.g., “I do things without thinking”) that are rated on a scale of 1 (*rarely/never*) to 4 (*always/almost always*). The Perceived Sociocultural Pressure Scale consists of 20 items, which assess perceived pressure for thinness [for women] or muscularity [for men]; items such as “My friends spend time critiquing other people’s appearance” are rated from 1 (*none*) to 5 (*a lot*).²⁵ Both the Barratt Impulsiveness Scale and the Perceived Sociocultural Pressure Scale have shown internal consistency and discriminant validity.²⁵ Participants also completed an Unhealthy Behavior Dissonance Scale, which was created for this study. This 14-item measure uses questions such as “I feel guilty when I watch TV instead of working out,” which are rated on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). In the present study, Cronbach’s alphas were 0.83 for impulsiveness, 0.84 for cognitive dissonance, and .89 for perceived sociocultural pressure for thinness. Across time points, rates of missing data for self-report measures were <7%; replacement of missing values via multiple imputation followed best-practice recommendations as articulated by Graham.²⁶

At baseline and each following assessments, participants had their height and weight measured in a research center (both twice, with the average retained for BMI calculation) and engaged in four days of ambulatory MVPA assessment. Participants wore Actigraph GT3X+ waistband accelerometers for four days, including at least one weekend day; standardized intensity cutpoints were used to identify minutes of MVPA (total per assessment and averaged across days) on days with ≥ 10 hours of wear time, as described by Matthews.²⁷ As college students show considerable variability in MVPA across time, missing or inadequate days of accelerometer wear were treated as missing at random (i.e., not imputed, with no discernible pattern to missingness).

Data Analysis Plan

Descriptive statistics were used to characterize the sample at baseline (on predictors and MVPA); baseline relations between predictors and MVPA were tested with Pearson’s correlations. For prospective tests, multilevel modeling was used to address attrition/missing data, the nested structure of MVPA data, and unequally spaced assessment points.²⁸ Valid accelerometer data were available for 333 participants at baseline, 322 participants at 6 weeks (1.5 months), 273 at 6 months, and 230 at 12 months. At each assessment 60–75% of the sample had four valid wear days (i.e., 10 or more hours of wear time), and an additional 20–25% had three valid wear days; less than 5% of the sample had only one valid wear day. The resulting sample size provided power > 0.80 to detect small-to-medium effects at both the between and within-person levels.

Analyses followed procedures outlined by Hox.²⁸ The null model showed an ICC of 0.33, indicating that multilevel analyses were appropriate for these data. Multilevel models also are ideal for repeated measures data collected at unequally spaced assessment points and any degree of missing data, as these models provide unbiased estimates. The linear effect of time was significant ($B = -5.48$, $p < 0.01$), though the quadratic effect was not ($B = 2.11$, $p = 0.11$). We then tested for a main effect of baseline impulsiveness, dissonance regarding engaging in unhealthy behaviors, and perceived pressure for thinness (each centered at the grand mean), as well as moderating effects of these predictors on the linear time-random effect of minutes of MVPA across four assessments using SAS PROC MIXED. All models controlled for gender and baseline BMI, which was centered at the grand mean. Finally, we examined whether gender (1) moderated the time effect on MVPA, and (2) further moderated interactions between psychosocial predictors and time on MVPA. Model fit was assessed using the chi-square test for difference between the -2 log likelihood for each model. Significance was identified as $p < 0.05$ for all tests.

As intervention conditions did not show significant differences in baseline MVPA ($B = 2.17$, $p = 0.14$) or in change over time ($B = 2.10$, $p = 0.15$), analyses collapsed across condition. Adding condition as a covariate did not meaningfully change results/conclusions. A similar pattern was observed for relations between racial identification and MVPA (baseline: $B = -2.01$, $p = 0.19$; change over time: $B = -2.11$, $p = 0.23$). Thus, condition and race were removed from final models for parsimony.

Results

Descriptive Statistics and Variability in MVPA over 12 Months

As indicated by the cognitive dissonance scale generated for this study, average baseline scores for dissonance regarding engaging in unhealthy behaviors indicated moderate discomfort with engaging in such behaviors ($M = 3.82$ on a 5-point scale, $SD = 0.56$). Women showed higher dissonance scores than men ($M = 3.86$ vs. $M = 3.70$, respectively; $t[197] = 2.53$, $p = 0.01$, $d = 0.29$). Average baseline impulsiveness scores ($M = 70.74$, $SD = 6.00$) were slightly higher than published norms for college students,²⁹ though the average score for perceived sociocultural pressure to be thin ($M = 2.56$, $SD = 0.70$) was similar to that observed in a previous sample of college students.³⁰ Men and women did not differ in their reports of impulsiveness or sociocultural pressure to be thin/muscular ($ps > 0.10$).

Across conditions, average baseline MPVA totaled 127.76 minutes ($SD = 49.76$); average time spent in MPVA per day was 37.04 minutes ($SD = 19.42$), and approximately 60% of participants met recommendations for 30 or more minutes of MVPA per day ($n = 200$).³¹ Of the total variability in MVPA over 12 months, only 33% was attributable to between-person differences (ICC = 0.33); a linear effect of time showed that participants tended to decrease their total MVPA over time ($B = -5.48$, $p < 0.01$), and only 45% of participants met MVPA recommendations at 12-month follow-up. As expected, there was a time-by-gender effect on MVPA, such that men showed greater MVPA than women across time ($F = 14.59$, $p < 0.001$); however, men also showed meaningful declines in MVPA over time (~30 minutes), whereas women showed smaller decreases (~15 minutes; interaction with time: $F = 4.15$, $p = 0.04$).

Relations between Psychosocial Descriptors and MVPA

At baseline, only impulsiveness significantly correlated with minutes of MVPA (bivariate correlation: $r = 0.16$, $p = 0.01$); cognitive dissonance regarding unhealthy behaviors ($r = 0.11$) and perceived sociocultural pressure to be thin ($r = 0.06$) were not significantly correlated with baseline MVPA ($ps > 0.10$). Baseline score for perceived sociocultural pressure toward weight control also showed no relation with *change* in MVPA (between-person across time or interactions with time; $ps > 0.24$). However, baseline self-report scores for both impulsiveness and cognitive dissonance regarding unhealthy behaviors showed significant relations with future change in MVPA. These between-person effects, which showed significant improvements in model fit over the growth model (i.e., time effect only; $ps < 0.01$), indicated that participants with higher (vs. lower) baseline impulsiveness scores ($F[580] = 2.92$, $p = 0.004$) and dissonance scores ($F[589] = 8.52$, $p = 0.003$) achieved more minutes of MVPA across time. A one-point difference in baseline impulsiveness score corresponded to 29.9 additional minutes of MVPA across assessments ($SE = 10.25$), and a one-point difference in baseline dissonance score corresponded to 17.6 additional minutes of MVPA across assessments ($SE = 6.04$; see Table 1). These differences are equivalent to 10–22% of recommended minutes of MVPA per week.³¹

Notably, however, interactions between baseline psychosocial scores and time showed that participants higher in impulsiveness and cognitive dissonance began the study with more MVPA minutes, but showed *sharper declines* over one year (evidenced in predictor-by-time interaction effects; $ps < 0.05$). These interaction effects also showed significant improvement in model fit ($ps < 0.01$). Participants one point higher (vs. lower) in baseline impulsiveness decreased MVPA by an additional 6.9 minutes per assessment ($SE = 3.51$; see Figure 1); similarly, participants one point higher (vs. lower) in baseline dissonance decreased MVPA by an additional 4.1 minutes per assessment ($SE = 2.09$). As depicted in Figure 2, participants who scored one standard deviation above (vs. below) the mean for cognitive dissonance engaged in approximately 10 more minutes of MVPA per four-day assessment period through 6-months; at 1 year, however, these participants decreased MVPA by almost 50% and showed six fewer minutes of MVPA. (Use of ± 1 standard deviation for illustrative purposes only.³²) These differences are equivalent to 3–5% of recommended minutes of MVPA per week (at each assessment point).³¹ Gender did not moderate relations between psychosocial predictors and MVPA over time ($ps > 0.25$).

Discussion

Consistent with previous assessments of college students, participants in the present study decreased their MVPA over one year.³³ This finding lends further support to students' perceptions that consistent engagement in MVPA is difficult during college,⁷ and verifies their self-reports with objective accelerometer data. Our observed gender difference also is consistent with some existing research in young adults, which show that men decrease MVPA at sharper rates than women.³⁴ These decreases occurred despite behavioral intervention, which included an educational video regarding obesity or two six-week group obesity prevention programs. Such findings underscore the need for intervention improvements that focus on long-term maintenance of MVPA in college. As college health

behaviors tend to persist over time and levels of physical activity in college predict weight gain up to 10 years later,³⁵ this work is critical for improving health and reducing morbidity risk during adulthood.

Results of the present study also show that college students who began a weight gain prevention program with elevated reported impulsiveness and cognitive dissonance regarding engaging in unhealthy behaviors showed more MVPA at baseline. Although cognitive dissonance was expected to predict greater MVPA (as dissonance from a discrepancy between desired or valued behavior and engagement in that behavior may prompt students to exercise),³⁶ impulsiveness was expected to predict *less* MVPA (as this characteristic may engage students in activities with immediate rewards and little discomfort).¹⁴ In the present study, however, all participants reported weight concerns at baseline; individuals with weight concerns may be especially motivated to overcome tendencies such as impulsiveness in order to maintain MVPA, as MVPA is expected to regulate weight.³⁷

Most critically, although students with elevated impulsiveness and cognitive dissonance began this study with higher MVPA, these students tended to decrease their MVPA *over time* more so than students with lower impulsiveness and dissonance. These differences reflected small-to-medium magnitude effects (relative to recommended MVPA per week) and were not significantly moderated by gender. Even if weight concerned students are highly motivated to regulate related impulsivity at the start of a weight control program, responding to the immediate rewards of more sedentary behaviors may be difficult to overcome long-term in the face of competing time and energy demands.^{7,38} Growing evidence shows that individuals with elevated impulsivity are highly sensitive to food reward and insensitive to related punishment (e.g., feeling overly full),³⁹ and such individuals show poorer self-regulation of eating behavior, particularly in the face of increased food variety (which is common in the modern food environment).⁴⁰ The present study is one of the first to identify impulsiveness as a risk factor for decreasing MVPA over time, which may further contribute to long-term weight control problems. Consequently, in addition to addressing eating-related mindful decision-making in treatment, focusing on overcoming immediate rewards to maintain MVPA over time may be particularly useful for students with elevated impulsiveness.

With respect to cognitive dissonance, it is possible that our cognitive dissonance scale captured discomfort about current lack of engagement in healthy behaviors, and that MVPA assessments reflected accurate perceptions about the discrepancy between desired and actual levels of activity. Dissonance associated with unhealthy behavior also may be more powerful for motivating sustained healthy eating than MVPA. As both of our active obesity prevention intervention programs (and similar programs) emphasized changes in both eating and MVPA,³⁶ future research to tease apart effects on these outcomes is needed. In addition, changing one's behavior is only one way to resolve dissonance. In everyday life, dissonance often is reduced by (temporarily) changing one's attitude toward a behavior; in this case, devaluing MVPA or giving oneself a reasonable excuse for not engaging in MVPA.⁴¹ Determining the frequency of such events among college students, and effective approaches

to preventing their negative effects on MVPA, may bolster the effectiveness of dissonance-based obesity prevention.

Overall, the present findings suggest that targeted MVPA-focused intervention for students who show elevated impulsiveness and cognitive dissonance may improve both MVPA and weight control outcomes for these individuals over the long term. Another implication is that it might be useful to add components to obesity prevention programs that seek to reduce impulsiveness, as this might result in greater MVPA over time and subsequent weight gain prevention effects.⁴² As noted, this is one of the first studies to examine prospective relations between psychosocial characteristics and MVPA in a sample at risk for weight gain. Strengths of this study include objective assessment of MVPA (waistband accelerometry), a long-term follow-up period with multiple assessment points (four assessments over 12 months), and a multilevel statistical approach to analyzing longitudinal data.

The larger clinical trial which provided these data was not designed with MVPA as the primary outcome; consequently, this study it is limited by the number of days of accelerometer wear at each time point (i.e., four). As health-based recommendations for MVPA indicate 30 minutes per day over five days (i.e., 150 minutes per seven-day week), the number of participants who met recommendations may be an underestimate; some participants may have achieved additional days with 30 or more minutes of MVPA that were not captured in our assessments. Also, as MVPA was not the clinical trial's main outcome, we assessed a restricted number of psychosocial characteristics that may be relevant for predicting MVPA in this population. Although we examined gender differences, our analyses may have been limited by the proportion of females (72%), potentially underpowering our ability to detect moderating effects. Finally, our conclusions are limited to students who express weight concerns at a particular time point; it is possible that students who develop weight concerns at later time points show different patterns of MVPA.

Conclusion

Among weight-concerned college students, who are at risk for weight gain and who begin an obesity prevention program with moderate or high levels of MVPA, those with elevated impulsiveness and cognitive dissonance about unhealthy behaviors show particular risk for decreasing MVPA over time. In our set of secondary analyses, differences in total minutes of MVPA based on these characteristics (i.e., approximately 5–30 minutes over four days) represent 3–22% of recommended MVPA per week.³¹ Such findings indicate that targeted, large-scale investigations of the effects of these factors on MVPA are warranted, and that increased attention to these characteristics in college obesity prevention programs could help to sustain intervention effects over time.

Acknowledgments

Funding Information

This work was supported by a grant (HD071900) from the National Institute of Child Health and Human Development, National Institutes of Health. This study is registered at www.clinicaltrials.gov (No. NCT01680224).

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Figure 1.
Minutes of MVPA at each assessment for ± 1 SD from the grand mean of baseline impulsiveness score.

Figure 2.
Minutes of MVPA at each assessment for ± 1 SD from the grand mean of baseline cognitive dissonance score.

Table 1.
Estimates for full prospective multilevel models predicting MVPA over one year (four time points).

<i>Impulsiveness</i>		<i>Cognitive Dissonance</i>		<i>Perceived Sociocultural Pressure</i>	
	<i>B (SE)</i>		<i>B (SE)</i>		<i>B (SE)</i>
Fixed Effects		Fixed Effects		Fixed Effects	
Intercept	82.99 (21.35) **	Intercept	77.40 (23.27) **	Intercept	123.78 (13.16) **
BMI (BP)	-0.25 (0.74)	BMI (BP)	-0.17 (0.74)	BMI (BP)	-0.21 (0.74)
Gender (BP)	-17.19 (4.79) **	Gender (BP)	-19.07 (4.82) **	Gender (BP)	-18.76 (4.87) **
Impulsiveness (BP)	29.89 (10.25) **	Dissonance	17.54 (6.04) **	Sociocultural Pressure	7.99 (4.85)
Time (WP)	8.23 (7.20)	Time	9.99 (8.11)	Time	-1.87 (4.49)
Impulsiveness *Time (BP *WP)	-6.89 (3.51) *	Dissonance *Time (BP *WP)	-4.11 (2.09) *	Sociocultural Pressure *Time (BP *WP)	-1.48 (1.68)
Random Effects		Random Effects		Random Effects	
Intercept	792.84	Intercept	788.31	Intercept	800.88
Residual	1361.47	Residual	1363.39	Residual	1369.15

Note:

*
 $p < 0.05$

**
 $p < 0.01$; BMI=Body Mass Index; BP=between-person (individual differences); WP=within-person (change).