Factors Affecting Active Video Gaming in Adolescence

Ji Hye Choi and Hua Wang

University at Buffalo, The State University of New York

Author Note:
Ji Hye Choi and Hua Wang, Department of Communication, University at Buffalo, The State University of New York.

Correspondence concerning this article should be addressed to Ji Hye Choi, Department of Communication, University at Buffalo, The State University of New York, Buffalo, NY 14260. E-mail: jihycho@buffalo.edu
Abstract

Despite the growing popularity of digital games as a new means of promoting physical activity, none of studies have identified important predictors of active video gaming while a number of factors have emerged as significant correlates of physical activity. Based on the ecological model of health behavior, personal, environmental, and social factors were used as three main constructs in this study, and we proposed and examined a structural model discussing the effects of personal, environmental, social factors on active video gaming and physical activity. In addition, the causal relationships between active video gaming and sedentary behavior, physical activity and sedentary behavior, as well as sedentary behavior and BMI were also examined in this study. Results indicated that only social factor was a significant predictor of active video gaming, even though personal, environmental, social factors were significantly associated with physical activity. Although both active video gaming and physical activity had significant influences on sedentary behavior, active video gaming was positively associated with sedentary behavior while physical activity was negatively associated with sedentary behavior. Finally, a positive association between sedentary behavior and BMI was found in this study.
Factors Affecting Active Video Gaming in Adolescence

Although regular physical activity (PA) is a well-known contributor to lifelong health, today’s young people are less likely to engage in PA. According to a recent report from the Centers for Disease Control and Prevention [CDC] (2012), only twenty-nine percent of high school students meet the national PA guideline for young people aged 6 to 17 years (i.e. at least 60 minutes of PA per day) recommended by the U.S. Department of Health and Human Services (Department of Health and Human Services, 2008). Lack of PA in childhood and adolescence is appeared to be a critical risk factor for chronic diseases (e.g., obesity, coronary heart disease, high blood pressure, stroke, type 2 diabetes, osteoporosis, and colon cancer) and even premature deaths in adulthood (Pate et al., 1995). Despite increases in the public awareness about the risk, unfortunately a sharp decrease in PA takes place during adolescence (Pate et al., 1995; Sallis, Owen, & Fisher, 2008). Thus, it may be argued that interventions to promote PA in adolescence should largely prevent the development of detrimental diseases, eventually leading to enhance public health in general.

As playing video games has been growing in popularity as a culture of the digital age, the idea of using video games to motivate adolescents to be more active emerged. Active video games (AVGs) are a genre of video games that require upper, lower, or full body movements, thereby having the potential to increase PA (Biddiss & Irwin, 2010). In fact, a large number of AVG studies have reported that AVG play increases energy expenditure, heart rate, and other PA indicators (Graves, Ridgers, & Stratton, 2008; Maddison et al., 2007; Peng, Crouse, & Lin, 2012). Thus, we may argue that AVGs are expected to increase adolescents’ PA as a substitute of traditional exercise equipment. Nonetheless, relatively few studies have investigated the potential predictors of AVG play, while growing body of PA studies have identified the reinforcing values
of PA in adolescence. In keeping with the findings of previous PA studies, this study aims to explore how personal, environmental, and social factors would influence AVG play in adolescence, which in turn helps develop effective game-based health interventions to promote PA behavior in adolescence.

Ecological Models: Correlates of Physical Activity in Multiple Levels

A useful theoretical framework for explaining why and how adolescents engage in PA is the ecological model of health behavior (Sallis et al., 2008). The model postulates that health behavior and health behavior change are influenced by multi-level factors, including intrapersonal, interpersonal, organizational, community, and policy influences. Drawing upon the core principle of ecological perspective, PA researchers have investigated the effects of personal, environmental, social factors on PA behavior, identifying the potential correlates of PA in adolescence (Ferreira et al., 2006; Sallis, Prochaska, & Taylor, 2000).

Personal factors in the PA research refer to individuals’ attitudes and beliefs related to PA behavior, such as affective orientation towards PA itself, and beliefs about health outcomes in PA. In fact, various personal variables (e.g., enjoyment in PA) have been discussed in existing PA studies, and it is generally assumed that positive attitudes toward PA and strong beliefs about health outcomes make PA fun and engaging (Deflandre, Antonini, & Lorant, 2004; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). Among a number of personal factors examined, enjoyment or fun in PA can be considered to be positive attitudes toward PA, and beliefs about health outcome in PA may include energy increases, feeling good, and feeling of success during PA. Thus, enjoyment or fun in PA as well as perceived energy increases, feeling good, and
feeling of success were hypothesized to be the main personal correlates of AVG play in the present study.

Enjoyment or fun in PA has been a consistent determinant of PA participation and engagement (Vallerand, 2001). Sallis and Owen (1998) and Salmon, Owen, Crawford, Bauman, & Sallis (2003) reviewed PA literature and found enjoyment in PA to be positively related to PA behavior, with higher levels of enjoyment in PA being associated with higher levels of PA. Similar findings were also found in other PA studies (Danaei et al., 2009; Ferreira et al., 2006). Since playing AVGs can be a substitute of PA, personal factors may affect active video gaming. In line with the findings of previous PA studies, we hypothesized that personal factors would positively influence active video gaming:

**H1a:** Personal factors will be positively associated with active video gaming.

**H1b:** Personal factors will be positively associated with physical activity.

Barriers to PA have been discussed as a strong influence, and as its external barriers, environmental factors emerged as significant determinants of PA. Environmental factors refer to the underlying conditions in which individuals are situated, including familial and societal structure (King et al., 2000). Although environmental factors and those influences on PA have been reported in multiple studies, factors mainly discussed in existing PA studies are accessibility and/or availability of exercising equipment (e.g., balls, bicycles, skates) and recreational facilities (e.g., playgrounds, parks), and neighborhood safety (Brownson et al., 2001; Ferreira et al., 2006).
Using exercise equipment and access to facilities have been reported to increase PA among adolescents (Bedimo-Rung, Mowen, & Cohen, 2005). Living in safe neighborhoods is also associated with greater PA behaviors (Bennett et al., 2007). A report from the Centers for Disease Control and Prevention (1999) found perceived neighborhood safety to be positively associated with PA. In contrast to the findings of previous PA studies, the direction of the relationship with active video gaming can be different because AVGs can be played in any settings including no available exercise facilities or unsafe neighborhoods. In other words, those adolescents may be encouraged to substitute traditional forms of PA with AVG play at home. For example, those who live in unsafe neighborhoods may engage in more active video gaming for the purpose of being active. Thus, it may be argued that environmental factors could be negatively associated with active video gaming.

$H2a$: Environmental factors will be negatively associated with active video gaming.

$H2b$: Environmental factors will be positively associated with physical activity.

A number of PA studies have indicated social support as an important social factor of PA and reported a consistent positive association (Caspersen, Pereira, & Curran, 2000; Springer, Kelder, & Hoelscher, 2006). In their studies of adolescents, social factors generally refer to one’s perception of how significant others help themselves participate in PA, including PA encouragement of adults in household, PA participation of adults in household, and so on (Duncan, Duncan, & Strycker, 2005). Sallis et al. (2000) reviewed studies and found support and direct help from family were consistently associated with regular PA. Aaron, Storti, Robertson, Kriska, and LaPorte (2002) and Ogden et al. (2006) have also reported that parent participation and encouragement in PA appear to be positively influences on adolescents’ PA levels. Thus, we
hypothesized that social factors would help adolescents more physically active and the adolescents may be also encouraged to use AVGs at home as a form of PA interventions.

**H3a:** Social factors will be positively associated with active video gaming.

**H3b:** Social factors will be positively associated with physical activity.

Sedentary behavior (SB) is defined as “activities that do not increase energy expenditure substantially above the resting level” (Pate, O’Neill, & Lobelo, 2008, p.174). Likewise, physical inactivity or insufficient PA may refer to SB. As a growing number of new media (e.g., computers, Internet, SNSs, and etc.) has emerged in recent years, sedentary behavior tends to be operationalized as passive screen-based activities such as watching television or videos and playing video games (Must & Tybor, 2005). However, the advent of AVGs has made screen time more active. In fact, extant studies on AVGs have reported a positive relationship between AVG play and PA. Biddiss and Irwin (2010) reviewed AVG studies and found that AVG play leads to light to moderate PA. Other studies have also reported a causal relationship between AVG play and vigorous PA (Maloney et al., 2008; Primack et al., 2012). While AVG studies have emphasized PA as a key outcome variable during AVG play, there is still a lack of understanding about the relationship between AVG play and SB. Based on the findings, the following hypotheses were proposed:

**H4:** Active video gaming will be negatively associated with sedentary behavior.

**H5:** Physical activity will be negatively associated with sedentary behavior.

Body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) is the most commonly used indirect measure of body fatness (Ogden, Carroll, Kit, &
Flegal, 2012). In fact, overweight and obesity in adolescence are often defined based on BMI. More specifically, adolescents with high values in BMI are termed as overweight (85th percentile \( \leq [\text{BMI}] < 95\text{th percentile} \)) or obese (\([\text{BMI}] \geq 95\text{th percentile} \)) (Orden & Flegal, 2010). As SB is considered to be a developing factor of overweight and obesity, a number of studies have discussed how screen-based activities such as television/video use, digital game play, and computer use would be associated with weight status (Eisenmann, Bartee, & Wang, 2002; Patrick et al., 2004). Nonetheless, the influence of screen-based activities on BMI in adolescence is still controversial. Although several studies have reported no relationship between screen-based activities and BMI (Gentile et al., 2009; McMurray et al., 2000), a systematic review of Tremblay et al. (2011) and other studies have indicated that screen-based activities (e.g., television/video use) lead to increases in BMI (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Utter, Neumark-Sztainer, Jeffery, & Story, 2003). In this study, we hypothesized that time spent on SB would be positively associated with BMI.

\( H6: \) Sedentary behavior will be positively associated with BMI.

**Method**

**Data Source and Sampling Procedure**

While multiple national datasets have been used to examine PA behavior in adolescence such as Youth Risk Behavior Surveillance System (YRBSS), few data sources include adolescents’ use of AVGs as a means of being physically active. The data for this study came from 2010 National Youth Physical Activity and Nutrition Survey (NYPANS), conducted by the Centers for Disease Control and Prevention (CDC). In the NYPANS, data were collected and analyzed to evaluate physical activity and dietary behavior in school-aged youth and to identify
determinants of their behavior, using a paper-and-pencil questionnaire. The NYPANS employed a three-stage cluster sample design to obtain a nationally representative sample of US high school students in grades 9 through 12, including public, Catholic, and private high school students in the 50 States and the District of Columbia. With the sampling frame, 12,907 students were selected as subjects, but 11,458 students (88% of the sampled students) responded to the request. After careful review of each questionnaire and also detecting and removing outliers, 10,481 questionnaires were used in the data analysis.

In terms of the descriptive characteristics of the sample, a majority (74.7%) of the respondents were from 15 to 17 years of age. Slightly more than half (50.3%) of the respondents were males and females were 49.7% of the entire sample. Similar proportions reported 9th grade (25.5%), 10th grade (25.2%), 11th grade (24.4%), and 12th grade (24.8%). Over 70 percent (70.1%) were non-Hispanic/Latino. More specifically, more than half of the respondents were White (38.7%) or African American (23.9%). Only 17.3 percent were Hispanic or Latino, and Asian was 2.4 percent.

Measures

*Personal Factor.* Five Liker-type scaled items were used to measure personal factor (on a scale of 1 to 5, with “1” being “strongly disagree” and “5” being “strongly agree”). All respondents were asked if they would agree or disagree with the following statements: (1) When I am physically active, I enjoy it, (2) When I am physically active, I find it fun, (3) When I am physically active, it gives me energy, (4) When I am physically active, my body feels good, and (5) When I am physically active, it gives me a strong feeling of success ($M = 4.21, SD = .67, \alpha = .84$).
Environmental Factor. Three items rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) were used to measure environmental factor. All respondents were asked if they would agree or disagree with the following statements: (1) At home there are enough pieces of sport equipment (such as balls, bicycles, skates) to use for physical activity, (2) There are playgrounds, parks, or gyms close to my home that are easy for me to get to, and (3) It is safe to be physically active by myself in my neighborhood (M = 3.84, SD = .88, α = .53).

Social Factor. Four items with 5-point scale (on a scale of 1 to 5, with “1” being “Never,” “2” being “1-2 times/week,” “3” being “3-4 times/week,” “4” being “5-6 times/week,” and “5” being “Daily”) were used to measure social factor. All respondents were asked to respond the following questions about the adults they live with. For example, during a typical week, how often does an adult in your household (1) encourage you to do physical activities or play sports?, (2) do a physical activity or play sports with you?, (3) provide transportation to a place where you can do physical activities or play sports?, and (4) watch you participate in physical activities or sports? (M = 2.45, SD = 1.11, α = .79).

Active Video Gaming. To measure active video gaming, all respondents were asked to report how many days in the past 7 days (ranged 0 to 7 days) they played active video games such as Wii, Dance Dance Revolution (DDR) (M = .87, SD = 1.31).

Physical Activity. Likewise, all respondents were asked to indicate how many days (ranged 0 to 7 days) they were physically active for a total of at least 60 minutes per day in the past 7 days (M = 4.13, SD = 1.86).

Sedentary Behavior. This construct was measured using three items, and all the items were scored on a 7-point scale (i.e., “1” being “I do not play video or computer games or use a
computer for something that is not school work,” “I do not watch DVDs or videos on an average school day,” or “I do not watch TV on an average school day”; “2” being “Less than 1 hour per day”; “3” being “1 hour per day”; “4” being “2 hours per day”; “5” being “3 hours per day”; “6” being “4 hours per day”; “7” being “5 or more hours per day”). Participants were asked to respond the following questions: On an average school day, how many hours do you (1) play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the Internet), (2) spend watching DVDs or videos? (Include DVDs or videos you watch on a TV, computer, iPod, or other portable device), and (3) watch TV? ($M = 3.45$, $SD = 1.27$, $\alpha = .56$).

Body Mass Index (BMI). BMI was calculated using objectively measured height and weight based on the following formula: $BMI = \frac{\text{Weight (in kg)}}{[\text{Height (in m)}]^2}$ ($M = 24.18$, $SD = 4.59$). According to the National Institutes of Health (NIH)’s BMI definitions, a BMI between 18.5 and 24.9 is considered to be healthy, a BMI between 25 and 29.9 is considered to be overweight, and obesity is defined as a BMI of 30 or greater. Hence, greater BMI represents being more fat.

Results

To test our research model, structural equation modeling (SEM) was performed. SEM is a multivariate analytical technique to simultaneously test hypothesized relationships between variables (Gefen, Straub, & Boudreau, 2000). In this study, the model postulated the effects of personal, environmental, and social factors on AVG play and PA. In addition, it also examined how AVG play and PA would affect sedentary behavior and BMI (see Figure 1). The correlations between key variables are shown in Table 1. A large number of missing values were
found in the dataset and some variables were not normally distributed to some extent. Thus, missing values were replaced with mean of each variable to get goodness of fit and modification indices in SEM.

Insert Table 1 Here

**Evaluation of the Research Model**

For the measurement model, construct validity was assessed using standardized factor loadings. Although an exception (i.e., SB1) was found in the procedure, other item loadings ranged from .43 to .84, above the recommended .40 minimum guideline (Hair, Anderson, Tatham, & Black, 1998). In addition, Cronbach’s alpha was used to assess construct reliability. In this study, alphas for the scales generally exceeded the commonly accepted level ($\alpha \geq .70$), but exceptions were found in both environmental factor ($\alpha = .53$) and sedentary behavior ($\alpha = .56$) scales. Since alphas from .50 to .70 indicate moderate internal reliability and thus all the scales were used for further analyses (Hinton, Brownlow, McMurray, & Cozens, 2004). Both factor loadings and alphas were shown in Table 2.

Insert Table 2 Here

The overall model fit was assessed using maximum likelihood in AMOS. A set of four fit indices was used to estimate its goodness of fit, including goodness of fit index ($GFI$), adjusted goodness of fit index ($AGFI$), comparative fit index ($CFI$), and root mean square error of approximation ($RMSEA$; Browne & Cudeck, 1993). Two commonly used fit indices [i.e., chi-square ($\chi^2$) and relative chi-square ($\chi^2/df$) statistics] were not included in this study because the measures are highly dependent on sample size (Bentler & Bonett, 1980).
The values for the structural model indicated a poor fit: $GFI = .95$, $AGFI = .94$, $CFI = .91$, $RMSEA = .056$. Modification indices suggested correlated measurement errors in the personal factor measure would improve overall model fit; covariance between item 3 and 4 ($MI = 1269.73$, estimated parameter change $[EPC] = .19$), covariance between item 4 and 5 ($MI = 590.25$, $EPC = .12$), and covariance between item 3 and 5 ($MI = 328.38$, $EPC = .09$). Goodness of fit has improved with each modification and therefore the modifications yielded a good fit: $GFI = .98$, $AGFI = .98$, $CFI = .97$, $RMSEA = .035$.

**Hypotheses Testing**

The modified research model and its significant structural paths and standardized coefficients are shown in Figure 2. Two non-significant paths were included in this model. More specifically, personal factors [PF] did not significantly predict active video gaming [AVG] ($\beta = -.01, t = -0.85$) and environmental factors [EF] did not predict AVG ($\beta = .00, t = 0.23$). However, other individual paths in this model were significant.

Hypotheses 1a and 1b suggested that PF would positively influence both AVG and PA. As explained above, the path from PF to AVG was not significant. Nonetheless, the path from PF to PA was significant ($\beta = .19, p < 0.001$), suggesting that personal factors had a significantly positive effect on physical activity. Hence, Hypothesis 1b was supported by the data.

Hypothesis 2a, which predicted a negative influence of EF on AVG, was not supported. As expected in Hypothesis 2b, however, the path from EF to PA was significant ($\beta = .14, p < 0.001$). Thus, environmental factors had a significantly positive influence on physical activity. Hence, the data also supported Hypothesis 2b.
Hypotheses 3a and 3b predicted that SF would have a positive impact on AVG and PA, respectively. As Hypothesis 3a predicted, the path from SF to AVG was significant ($\beta = .09, p < 0.001$). Hypothesis 3b, which predicted a positive influence of SF on PA, was also significant ($\beta = .26, p < 0.001$). Thus, Hypotheses 3a and 3b were supported, suggesting that social factors led to active video gaming as well as physical activity.

As to Hypotheses 4 and 5, which postulated that AVG and PA would be negatively associated with SA, both paths from AVG to SA and PA to SA were significant but different patterns were found in the individual paths. More specifically, physical activity had a negative influence on sedentary behavior ($\beta = -.16, p < 0.001$), while active video gaming had a positive influence on sedentary behavior ($\beta = .19, p < 0.001$). Hence, Hypothesis 5 was supported by data, but the data did not support Hypothesis 4.

Hypothesis 6 suggested that SA would have a positive influence on BMI. As Hypothesis 6 predicted, the path from SA to BMI was significant ($\beta = .07, p < 0.001$), suggesting that adolescents who were more likely to be sedentary held relatively higher BMI levels. Hence, Hypothesis 6 was supported by the data.

Discussion

Despite the growing popularity of digital games as a new means of promoting PA, none of studies have identified important predictors of active video gaming while a number of factors have emerged as significant correlates of PA. Using variables examined in the previous PA research, this study was expected to identify the factors associated with AVG play in
adolescence. Based on the ecological model of health behavior, personal, environmental, and social factors were used as three main constructs in this study, and thus we proposed and examined a structural model testing the effects of personal, environmental, social factors on AVG play and PA. Furthermore, the causal relationships between AVG play and SB, PA and SB, as well as SB and BMI were also examined in this study.

Although all the paths from personal, environmental, and social factors to PA were significant, only social factor had a significantly positive impact on AVG play. This result is consistent with extant PA studies that show the relationships between social support (e.g., encouragement) from parents, peers, or significant others and PA in adolescence (e.g., Prochaska, Rodgers, & Sallis, 2002; Butcher, 1983). However, the current results are not consistent with the ecological model of health behavior, which predicts the influence of multi-level factors (i.e., personal, environmental, and social factors) on PA. This indicates that social factor might be the most important determinant of PA, which makes adolescents more active. Future research could explore differences in how individual determinant of PA would affect AVG play or PA.

As a notable result, AVG play were positively associated with SB, and this finding was in contrast to the majority of PA studies in which PA was negatively associated with SB (see Salmon et al., 2003). These results show that AVG play can be thought to be SB, though AVGs have been viewed as a promising tool for PA promotion. This might be due to the fact that AVGs are perceived as a genre of digital games rather than a game-based PA intervention. In addition, adolescents might have less body movement during AVG play, and this may explain why this study failed to find a negative relationship between AVG play and SB. Future research may
focus on those with less body movement and discuss how their body movement can be increased while they play AVGs.

In this study, the relationship between SB and BMI is consistent with the results of previous studies (Marshall, et al., 2004; Utter, et al., 2003). Although this result differs from the results of some studies (e.g., Gentile et al., 2009; McMurray et al., 2000) that reports no relationship between SB and BMI, but our findings and the findings of other studies reported that SBs (i.e., screen-based activities) had significant and positive associations with BMI. By using a large national sample, this result further strengthens the results of previous studies. Overall, this indicates that those who are more likely to engage in SBs tend to be overweight and obese, with high values in BMI. In adolescence, SBs could be one possible explanation of the rapidly growing prevalence of overweight and obesity.

**Limitations**

Limitations in this study should be considered in the following studies. Although one of the notable strengths in this study is using the 2010 NYPANS data with a large national sample, this study also has some challenges inherent in the secondary data. More specifically, since this 2010 NYPANS was not designed to discuss AVG play in adolescents, detailed questions regarding AVG play (e.g., whether they or their households have had any gaming console for AVG play) could not be considered in this study. In addition, the quantity and quality of 2010 NYPANS questions to measure some constructs were not fully satisfactory. For example, Cronbach’s alpha for both environmental factor and sedentary behavior scales were .53 and .56, respectively, but no items enabled to be added to make those scales more reliable. Because of those imperfect scale reliabilities, the strength of correlations between key variables were
attenuated in general. As an interesting finding, a large number of U.S. high school students did not play AVGs. In other words, non-AVG users were oversampled and their distribution was shown to be positively skewed to some extent. In fact, more than half of the entire sample (58%) has never played AVGs, and only about 6% (5.7%) has played AVGs four days or more each week. As a result, this might lead to bias in estimation.
References.

Aaron, D. J., Storti, K. L., Robertson, R. J., Kriska, A. M., & LaPorte, R. E. (2002). Longitudinal study of the number and choice of leisure time physical activities from mid to late adolescence: implications for school curricula and community recreation programs. *Archives of pediatrics & adolescent medicine, 156*(11), 1075-1080.


Table 1. Bivariate Correlations between key constructs ($N = 10,481$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BMI</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Sedentary Behavior</td>
<td>.05**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Active Video Gaming</td>
<td>.02*</td>
<td>.16**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Physical Activity</td>
<td>-.05**</td>
<td>-.14**</td>
<td>.04**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Personal Factor</td>
<td>-.04**</td>
<td>-.17**</td>
<td>.01</td>
<td>.30**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Environmental Factor</td>
<td>-.10**</td>
<td>-.13**</td>
<td>.03**</td>
<td>.24**</td>
<td>.30**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>7. Social Factor</td>
<td>-.02</td>
<td>-.07**</td>
<td>.08**</td>
<td>.34**</td>
<td>.28**</td>
<td>.30**</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: *$p < .05$, **$p < .01$, two-tailed.
Figure 1. Structural equation model, with standardized coefficients
Table 2. Measurement Model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicators</th>
<th>Std. Loading</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Factor (PF)</td>
<td>PF1</td>
<td>.84</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>PF2</td>
<td>.79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PF3</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PF4</td>
<td>.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PF5</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td>Environmental Factor (EF)</td>
<td>EF1</td>
<td>.63</td>
<td>.53</td>
</tr>
<tr>
<td></td>
<td>EF2</td>
<td>.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EF3</td>
<td>.51</td>
<td></td>
</tr>
<tr>
<td>Social Factor (SF)</td>
<td>SF1</td>
<td>.69</td>
<td>.79</td>
</tr>
<tr>
<td></td>
<td>SF2</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SF3</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SF4</td>
<td>.77</td>
<td></td>
</tr>
<tr>
<td>Sedentary Behavior (SB)</td>
<td>SB1</td>
<td>.30</td>
<td>.56</td>
</tr>
<tr>
<td></td>
<td>SB2</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SB3</td>
<td>.65</td>
<td></td>
</tr>
</tbody>
</table>