

Self-determined Engagement in Physical Activity and Sedentary Behaviors of US College Students

ALESSANDRO QUARTIROLI^{‡1}, and HOTAKA MAEDA^{†2}

¹Department of Psychology, University of Wisconsin – La Crosse, La Crosse, WI, USA; ²Department of Kinesiology, University of Wisconsin – Milwaukee, Milwaukee, WI, USA

[‡]Denotes professional author, [†]Denotes graduate student author

ABSTRACT

International Journal of Exercise Science 7(1) : 87-97, 2014. Although the importance of promoting physical activity is well established, researchers have recently considered “sedentary behaviors” as another key risk factor for chronic disease. However, little is known about the motivational processes regulating sedentary behavior on a daily basis. A substantial amount of research has been based on the self-determination theory to examine the motivational processes regulating physical activity behaviors. However, only limited attention has been paid to sedentary behaviors from this theoretical perspective. This study aims to identify and understand motivational aspects related to sedentary behavior from a self-determination perspective. A convenience sample of undergraduate students (N=875) enrolled in a university required Lifetime Physical Activity and Fitness class completed an online survey which inquired about physical activity and sedentary behaviors as well as about motivational variables related to these behaviors. Physical activity variables were inversely and only slightly related to sedentary behavior ($\rho = -.084$ to $-.146$, $p < .05$). Psychological needs and behavioral regulations together explained 14.3% of the variance in moderate-to-vigorous physical-activity ($p < .001$), but only 2.8% of the variance in sedentary behavior ($p = .002$). These findings suggest physical activity and sedentary behaviors are explained by unique motivational factors.

KEY WORDS: College students, physical activity, sedentary behavior, self-determination theory

INTRODUCTION

The positive effects of regular moderate-to-vigorous physical activity (MVPA) participation are well known and include the prevention of non-communicable diseases, obesity, and reduced mortality (4). While the importance of promoting MVPA has been firmly established, researchers have recently started to investigate the unique impact of “sedentary behaviors” on health outcomes (32). Sedentary behaviors

are defined as any waking behavior characterized by an energy expenditure of ≤ 1.5 metabolic equivalents (METs) while in a sitting or reclining posture (25). Recent research has found that extended sedentary behaviors are associated with health risks and chronic diseases such as diabetes, cancers, cardiovascular disease (31), weight gain, obesity (23, 31), and higher chance of death (14). Importantly, the relationship between sedentary behavior and many health outcomes is independent of MVPA

(14, 19, 23) suggesting the two may uniquely impact health outcomes. Further, evidences from multiple animal studies suggest sedentary behavior elicits a unique physiological response within the muscle that is not reversed or mirrored by more intense physical activity (2, 13, 41). Genetic studies have also demonstrated evidence that physical activity and sedentary behavior have two entirely different phenotypes with unique underlying physiological mechanisms (8). Therefore, it is quite possible that sedentary behaviors and physical activity behaviors are also governed by unique motivational factors.

Physical activity researchers have found that motivation plays a relevant role in both sedentary and MVPA behaviors (3, 5). Self-determination theory (SDT) (10) has been recently used as the theoretical framework to explore the motivational factors that influence the level of PA engagement in college students (7, 33). SDT has been found associated with psychological (11) and physical well-being (26). SDT, in the physical activity realm, is characterized by a multidimensional approach to motivation aimed to explain what leads individuals to engage in physical activity behaviors.

On one hand, the engagement in the behavior is considered characterized by different degrees of behavioral regulations (9, 18). From the more controlled to the more autonomous, the continuum includes five different types of regulations (9). External regulation characterizes individuals participating in an activity based on the possibility of obtaining rewards or avoiding punishment. Introjected regulation is characterized by the internalization of the behavior without fully accepting it as one's own. That is,

people characterized by Introjected motivation will engage in the physically active behavior to avoid the guilt of not doing so. Identified regulation represents the participation in a behavior for its outcomes considered personally significant and important. The last and most autonomous level of extrinsic motivation is integrated regulation, characterized by full assimilation of the regulation and the behavior accepting it as one's own. Those individuals characterized by integrated regulation engage in physical activity because this behavior is congruent with their personal identity and self-evaluation. However, the behavior is still engaged in for separable outcomes rather than for the satisfaction inherent in engaging in the activity. The most autonomous regulation is known as intrinsic regulation. This characterizes engagement in the behaviors because the activity is fun, challenging, inherently satisfying, and enjoyable. Additionally, a state of amotivation, reflecting the total lack of motivation, was identified and placed at the least self-determined end of the regulation continuum (9).

An additional aspect of this theory entails the need for satisfaction of the three psychological needs: autonomy, competence, and relatedness (10). According to the SDT, facilitating these needs is essential in helping individuals to move from a more externally regulated engagement to physical activity to a more intrinsically regulate engagement, which would lead to higher level of lifetime adherence to these behaviors. The need for relatedness is based on the perception of being closed and connected to others (22). The need for competence is involves the perceived ability of being able to

successfully perform the desired behavior (22). The need for autonomy involves the perception of the activities as endorsed by or congruent with the self. In other words, autonomy represents the development of a perception of control over the desired behavior (22).

Past studies have demonstrated a positive relationship between self-determined motivation and positive exercise intentions, current exercise level, and physical fitness in adult and youth populations (7, 18, 27). Interventions based on SDT aimed at increasing MVPA have been consistently successful (29).

Rhodes and colleagues (23), in their systematic review stressed the need for more research on the cognitive, social, and environmental factors that could be involved in anti-sedentary behavior interventions. Motivational research focused on sedentary behavior could be part of the answer to this necessity. Although research on the motivational factors related to sedentary behavior is limited, recently, researchers have showed evidence that adults' sedentary behavior is regulated by both automatic (i.e., represented by habits) and controlled (i.e., represented by the intention to limit sedentary behaviors) motivational processes (5). Conroy and colleagues (5) looked at both self reported and directly observed sedentary behaviors and found that people frequently engaging in sedentary behaviors reported more sedentary behaviors. Interestingly, those characterized by higher level of intention to limit sedentary behavior displayed less self-reported sedentary behaviors and marginally less directly observed sedentary behaviors. Although this study targeted

college students and distinguished between qualitative motivational factors related to sedentary behaviors, it did not use the SDT as the theoretical framework.

Given that sedentary behavior and MVPA time are independent, (23) and evidence suggesting sedentary behavior and MVPA result in unique physiological responses (2, 13, 41), it is possible that the motivational factors that explain them are unique as well. If this relationship is true, it will support the need for interventions to account for both reducing sedentary time and increasing MVPA. To our knowledge, no studies have examined behavioral regulations and self-determination towards physical activity in relation to sedentary behaviors within the college students' population. Therefore, the general purpose of this study was to examine whether physical activity related behavioral regulations and psychological needs predict sedentary behaviors as strongly as MVPA in a convenience sample of college students.

METHODS

Participants

During the Spring semester of 2012, 1,022 college students at a moderately-large mid-Atlantic university were invited to participate in the study. All students were enrolled in the Lifetime Physical Activity and Fitness class, which is a required course for all undergraduate majors. A small amount of course extra credit was provided for those who participated. Eight hundred seventy five students volunteered to participate (85.6% of the potential sample). The participants were between 17 and 30 years of age (M age=20.29, SD=1.96

years). Most of the sample was Caucasian (N=594; 67.9%) (see Table 1).

Table 1. Demographic information.

	N	%
Age		
Freshmen	361	41.2
Sophomore	219	25
Junior	108	12.3
Senior	177	20.2
Transfer	10	0.1
Sex (Female)	567	65.1
Body mass index		
Underweight	75	9
Normal weight	507	60.7
Overweight	173	20.7
Obese	80	9.6
Ethnicity		
Caucasian	594	67.9
African American	171	19.5
Other	110	12.6

Protocol

Participants were given a link to an online survey through an e-mail message. The online survey started with informed consent information. Only those agreeing to participate had access to the rest of the survey. The survey included standardized measures, including the self-administered short form of the International Physical Activity Questionnaire (6), the Basic Psychological Needs in Exercise Scale (BPNES) (34), and the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) (15). In addition, few demographics items, developed specifically for this study, were included. This study was approved by the University and Medical Center Institutional Review Board at the institution where the study was completed.

Physical activity and sedentary behavior were measured using the short version of

the IPAQ (6), which is a self-administered 7-day recall questionnaire. The instrument includes seven items. Of the items, six measures three levels of physical activity (light, moderate, and vigorous) and one item assesses average daily sitting time as a measure of sedentary behavior. As in previous studies, measures of total sitting time have been preferred over assessing screen time to gauge sedentary behavior (23, 32). Craig and colleagues (6) found, in their US-based samples, that the IPAQ 7-day-short form questionnaire was characterized by a good test-retest reliability (intra-class correlation) ranging between 0.81 and 0.89 and criterion validity (Spearman's coefficient) ranging from .26 and .27, which was comparable to most other self-report validation studies. (6).

Following the IPAQ scoring protocol the metabolic equivalents minutes (MET min/wk) and minutes of physical activity per week, were calculated. Responses were transformed into minutes (hours * 60) and then to minutes of MVPA per week (17, 21). Thereafter, based on the physical activity guidelines for Americans (20), the participants were categorized in three groups, representing three different levels of physical activity engagement: "no or low active" (less than 150 minutes of MVPA per week), "moderately active" (150 to 299 minutes of MVPA per week) and "highly active" (over 300 minutes of MVPA per week). This variable that included three categories was named "PA guidelines." A similar, but dichotomous variable containing the category "no or low active" and "all others" (150 or more minutes of MVPA per week) was named "guidelines met."

BPNES (34) is a self-report instrument developed specifically for the context of exercise to evaluate participants' perceived psychological need fulfillment in exercise. This scale consists of 11 items assessing perceived competence, autonomy, and relatedness. Responses are provided on a 5-point Likert scale ranging from "1" (*"Strongly Disagree"*) to "5" (*"Strongly Agree"*). Wilson and colleagues demonstrated evidence for the validity and reliability of the BPNSE scale (40). The Cronbach's alpha coefficients for the current sample ranged between .80 and .86.

The BREQ-2 (15) is a 19-item inventory that assesses behavioral regulation in exercise. Responses are provided on a 5-point Likert scale ranging from "0" (*"Not true for me"*) to "4" (*"Very True for me"*). The psychometric characteristics of the BREQ-2 are well supported in the literature (34, 37). The Cronbach's alpha coefficients for the current sample ranged between .74 and .92. Relative Autonomy Index (RAI) was also computed which is a unidimensional index of the degree of self-determination (24). Higher RAI scores represent higher degrees of self-determined motivation of the individual.

Statistical Analysis

The entire set of responses was explored for missing data. Following the procedure suggested by Tabachnick and Fidell (28), because the percentage of missing data was small ($\approx 1\%$) with no evident pattern, each individual missed case was replaced using the median imputation technique (28).

For this study, behavioral regulations, RAI, and the basic psychological needs served as the independent variables. Sedentary behavior and physical activity were the

dependent variables. The physical activity engagement of the participants was analyzed based on the raw minutes per week and on the MET min/wk as suggested by the IPAQ scoring protocol, and also in categories based on the physical activity guidelines for Americans (20). This was done to develop a more comprehensive understanding of the level of physical activity in the participants.

The severe non-normal distributions among variables led to the use of Spearman correlations instead of Pearson correlation. Spearman correlation coefficients were calculated between the independent and dependent variables, and also among the dependent variables. Multiple regression models were used to predict square root transformed sedentary time, square root transformed MVPA time, and square root transformed MET minutes/wk from all independent variables. All analyses were two tailed with alpha levels of .05.

RESULTS

Participants reported moderate levels of psychological needs and of behavioral regulation (Table 2) with higher scores on the more self-determined motives and lower on the others. Consistent with the mean scores, the RAI indicated that the sample tended to be fairly self-determined ($M=6.35$; $SD= 6.32$). In terms of physical activity and sedentary behaviors, participants reported an average of 3 to 4 hrs/wk of MVPA ($M= 212.6$ min; $SD=123.7$ min). A total of 34.7% ($n=304$) reported no or low activity, 39.1% ($n=342$) reported moderate activity, and 26.2% ($n=229$) reported high activity.

COLLEGE STUDENTS SEDENTARY BEHAVIORS

Although most of the sample (65.3 %; n=571) met the physical activity guidelines, they also extensively engaged in sedentary behaviors, reporting 6-7 hrs/wk of sedentary behavior (M=382.0 min, SD=244.1min) (Table 2).

Table 2. Descriptive statistics.

	<i>n</i>	%
PA Guidelines		
Inactive	304	34.7
Moderately active	342	39.1
Highly active	229	26.2
Guidelines met	571	65.3
	<i>N</i>	<i>M(SD)</i>
Sedentary behavior (min)	875	382.0(244.1)
MET min/wk	875	9800(6004)
MVPA (min)	875	212.6(123.7)
Intrinsic Regulation	875	3.53(0.96)
Identified Regulation	875	3.71(0.81)
Introjected Regulation	875	3.01(1.1)
External Regulation	875	2.01(0.94)
Amotivation	875	1.55(0.89)
RAI	875	6.35(6.32)
Autonomy	875	3.62(0.83)
Competence	875	3.45(0.88)
Relatedness	875	3.72(0.91)

Note. PA guidelines = guidelines-based activity levels, guidelines met = meeting the minimum recommended guidelines, MVPA = moderate-to-vigorous physical activity time, MET min/wk = metabolic equivalent minutes per week, RAI = relative autonomy index

The levels of MVPA, the MET min/wk, meeting the minimum physical activity guidelines (guidelines met), and the categorized levels of physical activity (PA guidelines) were all significantly positively correlated to the satisfaction of the psychological basic needs (see Table 3).

Both activity variables (guidelines met and PA guidelines) also showed positively significant ($p < .05$) relationships with all of the behavioral regulations, with exception of external regulation and amotivation (see Table 3). Amotivation was not significantly related to any of the variables. For external regulation, only its relationship with MET min/wk was significant ($p < .05$). Intrinsic regulation ($p < .01$), identified regulation, autonomy, competence, and relatedness were all negatively related to sedentary behavior ($p < .05$) but the correlations were weak. Although the SDT variables were able to predict some of the variance of sedentary behavior ($\rho = -.074$ to $-.132$), the correlations were consistently stronger for predicting MVPA ($\rho = .114$ to $.305$), MET min/wk ($\rho = .095$ to $.250$), guidelines met ($\rho = .114$ to $.291$), and PA guidelines ($\rho = .111$ to $.288$).

Table 3. Spearman's Rho correlation coefficients ($N = 875$).

	SB	MVPA	MET min/wk	PA guidelines	Guidelines met
Intrinsic regulation	-.111***	.263***	.240***	.257***	.247***
Identified regulation	-.074*	.215***	.203***	.208***	.198***
Introjected regulation	-.063	.129***	.125***	.120***	.111***
External regulation	-.037	.055	.087*	.043	.015
Amotivation	-.018	.055	.037	.057	.058
RAI	-.035	.114***	.095**	.114***	.120***
Autonomy	-.092**	.228***	.190***	.211***	.209***
Competence	-.132***	.305***	.250***	.291***	.288***
Relatedness	-.110***	.184***	.140***	.145***	.152***

* $p < .05$, ** $p < .01$, *** $p < .001$

Note. RAI = relative autonomy index, SB = sedentary behavior, MVPA = moderate-to-vigorous physical activity, METs = metabolic equivalents per week, PA guidelines = guidelines-based activity levels, guidelines met = meeting the minimum recommended guidelines.

Psychological needs and behavioral regulation variables together were able to explain 2.8% of the variance of square root transformed sedentary behavior time, $F(8,866)=3.14$, $p = .002$, $R^2 = .028$, 90% CI[.006, .040]. The same independent variables were able to explain 14.3% of the variance of square root transformed MVPA time, $F(8,866)=18.01$, $p < .001$, $R^2 = .143$, 90%CI[.102, .171], and 10.6% of the variance of square root transformed MET min/wk, $F(8,866)=12.79$, $p < .001$, $R^2 = .106$, 90%CI [.069, .131].

Sedentary behavior was found slightly and negatively related to all the measures of physical activity (Table 4), with the highest of these correlations being the one with the level of MVPA engagement ($\rho = -.146$, $p < .001$).

Table 4. Spearman's Rho correlation coefficients ($N = 875$).

	SB	MVP A	METs /wk	PA Guidelines
MVPA	-.146***	-		
METs/wk	-.084*	.761***	-	
PA Guidelines	-.132***	.939***	.721***	-
Guidelines met	-.135***	.825***	.626***	.879***

* $p < .05$, ** $p < .01$, *** $p < .001$

DISCUSSION

Consistent with previous literature (23) this study showed a small, but statistically significant, negative relationship between MVPA and sedentary behaviors. Participants were predominantly active, reporting they met MVPA guidelines at a higher percentage than those reported by the American College Health Association (1). Despite their high activity levels, participants reported spending a considerable amount of time engaging in

sedentary behaviors. The current sample can be compared to the to the larger US population in terms of their engagement in sedentary behaviors based on the report by Matthews and colleagues (16), who investigated the prevalence of sedentary behaviors among the United States population from the 2003-2004 National Health and Nutrition Examination Survey. Although not specifically focused on college students, these authors found that their participants spent about 7.7 hours per day in sedentary behaviors (< 100 counts-minute⁻¹). Specifically, they showed that young adults between 16 to 29 years of age spent between 8.03(SE=0.08) and 7.48 (SE=0.11) hours in sedentary behaviors. The college students in the current study spent 6.37 hours per day engaging in sedentary behavior. Altogether, the results of this study showed that, although engaging in sufficient physical activity, college students still engage in high amount of sedentary behavior. Literature shows that there is a relationship between sedentary behavior and chronic disease, as well as other health outcomes, independent from the MVPA (14, 19, 23). Moreover it has been reported how the physiological response elicited by sedentary behavior cannot be not reversed or mirrored by more intense physical activity (2, 13, 41). Based on these premises, it is possible to sustain the need to develop interventions focused on reducing sedentary behavior and not exclusively focused on increasing MVPA.

Although considerable research shows that SDT constructs are associated with MVPA (12, 30, 39), this theoretical framework has not been used to directly address sedentary behaviors in college students. Consistent with previous research (17, 21), participants in this study reported moderate levels of

psychological needs and of behavioral regulation with higher scores on the more self-determined motives and lower on the others. Confirming previous literature, this study showed how basic need satisfaction and self-determined behavioral regulations were associated with higher MVPA (7, 33); while, on the other hand, they showed a negative relationship with sedentary behaviors, albeit weak in magnitude.

In the current study, the variables related to SDT were correlated more strongly with physical activity levels rather than sedentary behavior. Therefore, it is possible to sustain that the engagement levels in sedentary behavior might be led by behavioral regulations and psychological needs satisfaction levels that differ from those that explain active behaviors. This indicates that interventions aiming to reduce sedentary behavior may be more effective if they target changes in motivational factors that are different from those (e.g., psychological needs, behavioral regulations) that are typically targeted in physical activity interventions. Some confirmation for this hypothesis can be found in the findings of Wang and colleagues (35). Based on a sample of Singaporean students, they concluded that programs focused on the reduction of sedentary behaviors might not necessarily increase physical activity. Moreover, they observed the need to develop gender and age-specific interventions addressing multiple sedentary behaviors.

All in all, this study confirms the idea that sedentary behavior and physical activity needs to be treated as different entities (19, 23). Therefore, developing and implementing interventions that specifically target sedentary behaviors

structured within a self-determination framework could lead to effective reductions in sedentary behavior. Moreover, due to the different relationship between sedentary behavior and physical activity engagement with the self-determination constructs identified with this sample, interventions focused independently and concurrently on both these behaviors, structured within the self-determination theoretical framework, could potentially lead to more effective results.

The use of self-reported assessments might have limited the accuracy of the PA and sedentary behavior measurements, possibly leading to over-reported levels of active behaviors and under-reported time spent engaging in sedentary behaviors. Future studies might want to look into using objective measurements, such as accelerometers aiming to provide more accurate measurements of the levels of PA and sedentary behavior engagement.

Using the BREQ-2 to measure the different behavioral regulation in exercise was also a limitation. The BREQ-2 does not include a subscale assessing the integrated regulation, which instead it has been added to the more recent BREQ-2R (36, 38). Although this choice was led by the intention of the authors of comparing the results with this study with the previous literature, which extensively use the BREQ-2, the use of the more complete instrument would have certainly enhanced its results. Future studies should consider the use of the BREQ-2R aiming to a more comprehensive understating of how individuals are motivated to engage in physical activity.

An additional limitation to this study is characterized by the inclusion in the sample of exclusively college students, which limits the possible generalization of the findings. The cross-sectional nature of the study, prevent the deduction of causal relationships between behavioral regulations and physical activity and sedentary behaviors.

In conclusion, the study showed that sedentary behavior and physical activity behaviors might be explained by unique motivational factors. It could be important to develop and implement interventions within the self-determination theory that, in addition to targeting physical activity behaviors, specifically address the decrease in sedentary time. Developing these interventions could be functional in the development of a deeper understanding of the motivations behind the college students engaging in sedentary behavior. These interventions, not only may witness higher level of success, but could also be more efficient and cost-effective. Moreover, future studies could also explore the possibility of developing scales measuring SDT behavioral regulations specifically related to sedentary behaviors. These scales could help in monitoring the mediating effects of these constructs in developing and implementing interventions targeting sedentary behavior based on the SDT. The development of SDT questionnaires validated in the context of sedentary behaviors may add further to the knowledge of the relationship between SDT and sedentary behaviors. Moreover, future studies should investigate various other psychological constructs that may mediate prolonged sedentary behavior and potentially strengthening and enhancing

the understanding of the psychological factors influencing sedentary behaviors.

REFERENCES

1. American College Health Association -National College Health Assessment [ACHA-NCHA] (2011). Retrieved May 27th, 2012 from http://www.acha-ncha.org/docs/ACHA-NCHA-II_ReferenceGroup_ExecutiveSummary_Fall2011.pdf.
2. Bey L, Hamilton M. Suppression of skeletal muscle lipoprotein lipase activity during physical inactivity: a molecular reason to maintain daily low-intensity activity. *J. Physiol* 551(Pt 2): 673-682, 2003.
3. Biddle S, Nigg C. Theories of exercise behavior. *Int J Sports Psychol* 31(2): 290-304, 2000.
4. Blair SN, Sallis RE, Hutber A, Archer E. Exercise therapy - the public health message. *Scand J Med Sci Sports* 22(4): e24-e28, 2012.
5. Conroy D, Maher J, Elavsky S, Hyde A, Doerksen S. Sedentary Behavior as a Daily Process Regulated by Habits and Intentions. *Health Psychol* 32(11): 1149-1157, 2013.
6. Craig CL, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 35(8): 1381-95, 2003.
7. Daley A, Duda JL. Self-determination, stage of readiness to change for exercise, and frequency of physical activity in young people. *Eur. J. Sport Sci* 6(4): 231-243, 2006.
8. de Vilhena e Santos D, Katzmarzyk P, Seabra A, Maia J. Genetics of physical activity and physical inactivity in humans. *Behav Genet* 42(4): 559-578, 2012.
9. Deci E, Ryan R. Self-determination theory: a macrotheory of human motivation, development, and health. *Can. Psychol* 49(3): 182-185, 2008.
10. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior*. New York: Plenum, 1985.

11. Deci EL, Ryan RM. Facilitating optimal motivation and psychological well-being across life's domains. *Can. Psychol* 49(1): 14-23, 2008.
12. Duncan LR, Hall CR, Wilson PM, Jenny O. Exercise motivation: A cross-sectional analysis examining its relationships with frequency, intensity, and duration of exercise. *Int J Behav Nutr Phy* 7: 1-9, 2010.
13. Hamilton M, Etienne J, McClure W, Pavey B, Holloway A. Role of local contractile activity and muscle fiber type on LPL regulation during exercise. *Am J Physiol* 275(6 Pt 1): E1016-E1022, 1998.
14. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc* 41(5): 998-1005, 2009.
15. Markland D, Tobin V. A modification to the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. *J Sport Exerc Psychol* 26(2): 191-196, 2004.
16. Matthews CE, Chen KY, Freedson PS, et al. Amount of time spent in sedentary behaviors in the United States, 2003-2004. *Am J Epidemiol* 167(7): 875-881, 2008.
17. Morrow JR Jr, Bain TM, Frierson GM, Trudelle-Jackson E, Haskell WL. Long-term tracking of physical activity behaviors in women: the WIN Study. *Med Sci Sports Exerc* 43(1): 165-170, 2011.
18. Moustaka FC, Vlachopoulos SP, Kabitsis C, Theodorakis Y. Effects of an autonomy-supportive exercise instructing style on exercise motivation, psychological well-being, and exercise attendance in middle-age women. *J Phys Act Health* 9(1): 138-150, 2012.
19. Owen N, Bauman A, Brown W. Too much sitting: a novel and important predictor of chronic disease risk? *Br J Sports Med* 43: 81-83, 2009.
20. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report, 2008. Washington, DC: U.S. Department of Health and Human Services, 2008.
21. Quartiroli A, Zizzi S. A tailored wellness intervention for college students using internet-based technology: A pilot study. *Int Electron J Health Educ* 15(1): 37-50, 2012.
22. Reis H, Sheldon K, Gable S, Roscoe J, Ryan R. Daily well-being: The role of autonomy, competence, and relatedness. *Pers Soc Psychol* 26(4): 419-435, 2000.
23. Rhodes RE, Mark RS, Temmel CP. Adult sedentary behavior: a systematic review. *Am J Prev Med* 42(3): e3-e28, 2012.
24. Ryan RM, Connell JP. Perceived locus of causality and internalization: Examining reasons for acting in two domains. *J Pers Soc Psychol* 57(5): 749-761, 1989.
25. Sedentary Behaviour Research Network. Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours." *Appl Physiol Nutr Metab* 37(3): 540-542, 2012.
26. Standage M, Gillison FB, Ntoumanis N, Treasure GC. Predicting students' physical activity and health-related well-being: A prospective cross-domain investigation of motivation across school physical education and exercise settings. *J Sport Exerc Psychol* 34(1): 37-60, 2012.
27. Stephan Y, Boiché J, Le Scanff C. Motivation and physical activity behaviors among older women: A self-determination perspective. *Psychol Women Quart* 34(3): 339-348, 2010.
28. Tabachnick BG, Fidell LS. *Using Multivariate Statistics*. The United States of America: Pearson; 2007.
29. Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: A systematic review. *Int J Behav Nutr Phys Act* 9: 78, 2012.
30. Thøgersen-Ntoumani, C, Ntoumanis, N. The role of self-determined motivation in the understanding of exercise-related behaviours, cognitions and physical self-evaluations. *J Sports Sci* 24(4), 393-404, 2006.
31. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults a systematic review of

COLLEGE STUDENTS SEDENTARY BEHAVIORS

longitudinal studies, 1996-2011. *Am J Prev Med* 41(2): 207-215, 2011.

32. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab* 35(6): 725-740, 2010.

33. Ullrich-French S, Smith A, Cox A. Attachment relationships and physical activity motivation of college students. *Psychology & Health* 26(8): 1063-1080, 2011.

34. Vlachopoulos SP, Michailidou S. Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. *Meas Phys Educ Exerc Sci* 10(3): 179-201, 2006.

35. Wang CKJ, Koh KT, Biddle SJH, Liu WC, Chye S. Physical Activity Patterns and Psychological Correlates of Physical Activity among Singaporean Primary, Secondary, and Junior College Students *ICHPER-SD Journal of Research* 6(2): 3-9, 2011.

36. Wilson PM, Rodgers WM, Loitz C, Scime G. It's who I am really! The importance of integrated regulation in exercise contexts. *J Appl Biobehav Res* 11(2): 79-104, 2006.

37. Wilson PM, Rodgers WM. The relationship between perceived autonomy support, exercise regulations and behavioral intentions in women. *Psychol Sport Exerc* 5(3): 229-242, 2004.

38. Wilson PM, Sabiston CM, Mack DE, Blanchard CM. On the nature and function of scoring protocols used in exercise motivation research: An empirical study of the behavioral regulation in exercise questionnaire. *Psychol Sport Exerc* 13(5): 614-622, 2012.

39. Wilson, PM, & Rogers, WT. Examining relationships between psychological need satisfaction and behavioural regulations in exercise. *J Appl Biobehav Res* 13(3), 119-142, 2008.

40. Wilson, PM, Rogers, WT, Rodgers, WM, & Wild, TC. The Psychological Need Satisfaction in Exercise Scale. *J Sport and Exercise Psy* 28(3): 231-251, 2006.

41. Zderic T, Hamilton M. Physical inactivity amplifies the sensitivity of skeletal muscle to the

lipid-induced downregulation of lipoprotein lipase activity. *J Appl Physiol* 100(1): 249-257. 2006.