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**Perceived stress, stress management, and vigorous physical activity  
among college students**

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**Perceived stress, stress management, and vigorous physical activity  
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**by**

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**Thesis**

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## **Abstract**

### **Perceived stress, stress management, and vigorous physical activity among college students**

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Obesity is a public health concern and obesity rates increase from adolescence to adulthood. Therefore, the period between 18-24, known as emerging adulthood, may be a crucial period in the development of obesity. Physical activity (PA) is one component of obesity and levels of physical activity decline significantly during emerging adulthood. Additionally, stress is inversely associated with PA, with greater levels of PA associated with lower levels of stress. While most research has focused on whether or how PA may improve stress, much less has focused on how the experience of stress may be related to levels of PA. The limited existing research with a focus on the latter has found that stress negatively impacts PA. However, even less research has examined the associations between stress and vigorous PA (VPA) in emerging adulthood, a crucial period in the development of obesity. Additionally, research has not explored the potential role of perceived stress management ability in the relationship between perceived stress and VPA. Linear regression analyses were run to examine the relationship between perceived

stress and days and minutes of past week VPA among first-year college students and to test whether the relationship between perceived stress and VPA was moderated by perceived stress management ability. In unadjusted models, perceived stress was significantly negatively associated with both minutes and days of VPA, indicating that perceived stress may be a barrier to VPA, but in models adjusted for gender and body mass index (BMI), these associations were no longer significant, indicating that there was no association between perceived stress and VPA taking into account gender and BMI. Moderation of the relationship between perceived stress and VPA was not found, indicating that and that the relationship between perceived stress and VPA did not differ by perceived stress management ability in this population. These results are inconsistent with previous research that has found a significant negative relationship between perceived stress and physical activity. Additionally, gender was significantly associated with minutes of VPA. Possible reasons for the inconsistency of these findings and previous research, along with limitations of the current study and future directions are discussed.

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## **Introduction**

The prevalence of obesity has increased dramatically in the United States over the past 30 years, becoming a significant public health concern (Baskin, Ard, Franklin, Allison, 2005). Obesity is commonly assessed using a measure of body mass index (BMI), a number calculated using individual height and weight. In adults, obesity is determined by having a BMI of 30 or higher (Centers for Disease Control and Prevention ((CDC), 2011). Data from the National Health and Nutrition Examination Survey (NHANES), a database containing height and weight measurements from a representative sample of the United States' population, found that the prevalence of obesity among American adults aged 20 years and older during 2009 to 2010 was 35.7%, comprising 78 million individuals (Ogden, Carroll, Kit, & Flegal, 2012). Among adolescents aged 12-19 years during 2009 to 2010, the prevalence of obesity was 18.4% (Fryar, Carroll, & Ogden, 2012). The transition from adolescence to adulthood appears to be a critical developmental period in the development of obesity. The developmental period that lies between adolescence and adulthood, known as emerging adulthood, is characterized by a decrease in physical activity and an increase in obesity (Gordon-Larsen, Adair, Nelson & Popkin, 2004). Due to the role of physical activity in obesity prevention (Litterell et al., 2003; Simkin-Silverman et al. 2003; Muto & Yamauchi, 2001), it is important to understand why emerging adults fail to engage in adequate physical activity. Research has found an inverse relationship between stress and physical activity, however, more research examining this relationship among emerging adults is needed for obesity prevention.



The prevalence of obesity increases steeply from adolescence to adulthood. Data from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative, school-based longitudinal study of adolescents into adulthood broken down into three waves of data collection, found that the incidence of obesity from waves II to III (ages 13-20 to ages 19-26 respectively) was 12.7%. That is, 12.7% of participants who were included and remained in the study changed in status from non-obese to obese (Gordon-Larsen, Adair, Nelson & Popkin, 2004). By comparison, only a small proportion of participants changed in status from obese to non-obese (Gordon-Larsen, Adair, Nelson & Popkin, 2004). This study indicates that during the five-year period of the study when participants were transitioning into emerging adulthood, more than 1.9 million adolescents became obese in the United States (Gordon-Larsen, Adair, Nelson & Popkin, 2004). These findings demonstrate the importance of emerging adulthood in the perpetuation of obesity in the United States.

Emerging adulthood, as conceptualized by Jeffrey Jensen Arnett (2000) as a theory of development, is a distinct stage of the life course that occurs during the years between ages 18 to 24. This stage is characterized by identity exploration and increased autonomy in decision-making. In 2010, about 10% of the United States' population, or 30,672,088 Americans, was between the ages of 18 and 24 (Census Bureau, 2011). As part of identity formation, individuals in this stage explore new behaviors and ideologies and are more autonomous in decision-making, suggesting that emerging adulthood may also be a critical period for developing health behaviors (Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008).

The etiology of obesity is complex and indisputable causes and mechanisms have not yet been determined, but several hypothesized causes have been suggested including genetic, metabolic, and dietary factors as well as inadequate physical activity (Bray, York, & DeLaney, 1992). While the causes of obesity are complex, research consistently suggests that inadequate physical activity is a significant component of the etiology of obesity. For example, research has found that obesity is caused by an energy imbalance, or a positive energy balance, where energy consumption is greater than energy expenditure (Esparza, et. al, 2000; Goran & Treuth, 2001) and energy expenditure is highly dependent on physical activity. Even among ethnic groups that carry a genetic susceptibility for obesity, such as Pima Indians, those who engage in more physical activity exhibit lower rates of obesity (Esparza, et al., 2000), suggesting the significance of physical activity in the development of obesity, above and beyond genetic factors.

Physical activity is defined as any movement produced by skeletal muscles that requires energy expenditure (World Health Organization) or movement that enhances health (Physical Activity guidelines for Americans, 2008). Physical activity can be categorized into the categories light, moderate, and vigorous, based on the ratio of exercise metabolic rate (MET) of a specific activity to the exercise metabolic rate of sitting quietly. Physical activity is considered light when one's METs are below three, moderate when one has reached a level between three and six METs, and vigorous when one has reached a level higher than six METs (CDC, 1999). An example of light physical activity is performing light housework, of moderate physical activity is walking slower than five miles per hour, and of vigorous physical activity is running or walking faster

than five miles per hour (CDC, 1999). According to the 2008 Physical Activity Guidelines for Americans, adults aged 18 and older are recommended to engage in 150 minutes of moderate physical activity per week or 75 minutes of vigorous physical activity per week in intervals of at least ten minutes, or some equivalent combination of moderate and vigorous physical activity (CDC, 2011).

Emerging adulthood is a particularly significant developmental period with respect to obesity, because, while this period is crucial in the establishment of health behaviors, such as regular physical activity, research has found that physical activity levels actually decline more during this developmental period than during any other period of the lifespan (Nelson, Gortmaker, Subramanian & Wechsler, 2007; Stephens, Jacobs, & White, 1985; Caspersen, Christensen, & Pollard, 1986). For example, data from Add Health indicate that the proportion of individuals meeting national physical activity recommendations dropped from 33.6% in adolescence (mean age: 16.0) to only 12.7% in young adulthood (mean age: 22.6) (Gordon-Larsen, Nelson, & Popkin, 2004). This decrease in physical activity parallels the increase in obesity during the transition from adolescences to adulthood. These findings indicate that the emerging adulthood population is an important age group to target for obesity prevention through physical activity.

### Stress and Stress Management

Research has found an inverse relationship between stress and physical activity. Stress has been defined as any environmental, social, or internal demand(s) that motivates an individual to adjust his or her typical behavior in order to cope with the demand(s)

(Holmes & Rahe, 1967; Lazarus & Folkman, 1984, seen in Thoits, 1995). The three main categories of stressors found in the research in this area are life events, chronic strains, and daily hassles (Thoits, 1995). Life events are major changes within a short period of time, chronic strains are recurrent stressors that persist over long periods of time, and hassles are small events that occur throughout the course of a day (Thoits, 1995).

Individuals use coping resources and coping strategies to manage stress. Coping resources are social and individual characteristics that may be used to manage stress, while coping strategies are behavioral or cognitive strategies to manage stress (Gore, 1985; Lazarus & Folman, 1984; seen in Thoits, 1995). Research supports that physical activity is a coping strategy for managing stress. The increased fitness resulting from aerobic physical activity reduces individuals' stress responses involving the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis (Scully, Kremer, Meade, Graham, Dudgeon, 1998; Rimmele, Seiler, Marti, Wirtz, Ehlert, & Heinrichs, 2009). Indeed, exercise is used by some as a coping strategy for dealing with stress (Baum & Posluszny, 1999; Stetson, et. al, 1997). However, research has also found that stress and physical activity are inversely related (Ng & Jeffery, 2003), suggesting that physical activity is under-utilized as a coping strategy to manage stress.

While the majority of research in the area of stress and physical activity has examined the impact of physical activity on stress, some, albeit less, research has examined the impact of stress on physical activity. Studies with this focus, interestingly, have found that stress reduces physical activity. In one such study, Lutz and colleagues (2007) found that perceived stress predicted lower levels of physical activity at a two-

month follow-up, and that physical activity levels did not predict perceived stress at a two-month follow-up. In another, Stetson and colleagues (1997) found that during weeks in which participants reported high perceived stress, they skipped significantly more planned exercise sessions and had more negative exercise related cognitions. In a third, Steptoe and colleagues (1996) found that vigorous physical activity significantly decreased among college students who were academically stressed, but did not change significantly during the course of the study among students who were in the non-academically stressed comparison group. These preliminary findings are significant in the study of stress and physical activity, because they suggest that while physical activity is a beneficial coping strategy to manage stress, those who are stressed are less likely to engage in physical activity. Thus, emerging adults who may benefit the most from physical activity may be least likely to be physically active, rendering a vulnerable population with respect to inadequate physical activity even more vulnerable.

However, the relationship between stress and physical activity may be more nuanced. Some research suggests that the impact of stress on physical activity may vary by individual characteristics (Lutz, Stults-Kolehmainen, & Bartholomew, 2010). One's level of stress management ability may be an individual characteristic that moderates this relationship. For example, a high ability to manage stress may negate the negative impact of stress on physical activity and alternatively a low ability to manage stress may exacerbate the impact of stress on physical activity during high-stress periods. For example, Lutz, Stults-Kolehmainen, and Bartholomew (2010) found that higher levels of stress predicted greater physical activity among female college students who were in the

maintenance stage of change or who have been regularly active for more than six months, but predicted less physical activity for those in lower stages of change, such as those who have no intention to be physically active or intend to be physically active, but who have not been regularly physically active for the entire past six months (Prochaska & DiClemente, 1983). These findings suggest that individuals who engage in regular physical activity may use physical activity as a coping strategy to manage stress, while individuals who do not regularly engage in physical activity may perceive stress as a barrier to physical activity. Because research such as this suggests there are nuances in the relationship between stress and physical activity, it is conceivable that this relationship may also vary by stress management ability.

Limitations in the field of stress and physical activity exist and, as such, more research in this area is needed. As previously discussed, one limitation of research in this area is that research has primarily focused on the impact of physical activity on stress, while much less has focused on the impact of stress on physical activity. Limitations within the research that does examine the impact of stress on physical activity include a lack of inclusion of diverse populations, a lack of focus on emerging adulthood, a crucial period in the prevention of obesity through physical activity, and a lack of research examining the role of stress management ability in the relationship between stress and physical activity. For example, the sample for the study conducted by Lutz and colleagues (2007) consisted of blue collar workers and the sample for the study conducted by Stetson and colleagues (1997) consisted of a majority white (82%) women (100%) who were regular exercisers already enrolled in health clubs. Additionally, the

mean age of the samples for the studies conducted by Lutz and colleagues (2007) and Stetson and colleagues (1997) was 44 years and 35 years, respectively. The sample for the study conducted by Steptoe and colleagues (1996) consisted of older college students in London with a mean age of 22.4. Although the sample for this study includes emerging adults, much more research on this age group is needed considering the significance of emerging adulthood in the development of obesity. No previous studies on the potential moderating role of stress management ability in the relationship between stress and physical activity were found. Therefore, additional research is needed with more diverse samples, a focus on emerging adults, an examination of the impact of stress on physical activity, and an examination of the potential moderating role of stress management ability in the relationship between stress and physical activity.

College students may be a fitting population with which to examine the impact of stress on physical activity among emerging adults. Most college students fall within the developmental period of emerging adulthood, or between the ages of 18 and 24 (McGinnis, 1992; Bungum & Vincent, 1997). About 21 million college students were enrolled in college in the United States in 2010, the highest enrollment ever recorded, and that number is expected to continue to grow until 2020 (Aud, et. al, 2011). Research has found that, like the general emerging adult population, college students similarly fail to engage in adequate physical activity. The National College Health Assessment (NCHA) found that less than half of all college students in the United States engaged in adequate physical activity (NCHA, 2011). With respect to stress, the college student population has unique experiences which expose them to stressors, such as academics, finances, and

intimate relationships (NCHA, 2011) which may increase their levels of perceived stress. In fact, the stress experienced by emerging adults in college is quite high. For example, with respect to academics, finances, and intimate relationships, 45%, 36%, and 32% of students reported that these three domains were traumatic or very difficult to handle within the last 12 months respectively. More broadly, more than half of college students report experiencing greater than average or tremendous stress (NCHA, 2011). The high levels of stress experienced by college students makes this group a prime population to examine to better understand the potential impact of stress on physical activity at a crucial developmental period in the development of obesity.

As obesity continues to pose a public health threat to Americans, it is important to gain a better understanding of factors related to physical activity among emerging adults. While research has demonstrated an inverse relationship between stress and physical activity, more research on this relationship among emerging adults is needed. Additionally, more research is needed to determine whether the relationship between stress and physical activity is moderated by stress management ability among this population. Because college students are entering emerging adulthood and experience high levels of stress, they represent an important population to study in order to better understand the impact of stress of physical activity and the potential moderating role of stress management ability. Thus, the purpose of this study was to examine the relationship between perceived stress and vigorous physical activity (VPA) and to examine whether perceived stress management ability moderates the relationship between perceived stress and VPA. For this study, two constructs of VPA were created-



the number of days during the past week that one engaged in VPA and the number of minutes during the past week that one engaged in VPA. These constructs will subsequently be referred to as days of VPA and minutes of VPA respectively. VPA was broken down into days and minutes per week because they may represent very different aspects of how one is physically active and may be differentially impacted by stress. For instance, stress may impact whether an individual will participate in a VPA session at all, representing days of VPA. Once one has initiated a VPA session, stress may cause one to reduce the time spent in VPA, representing minutes of VPA.

### Hypotheses

It is hypothesized that a negative association between perceived stress and days of VPA will be found and that perceived stress management ability will moderate the relationship between perceived stress and days of VPA. Similarly, it is hypothesized that a negative association between perceived stress and minutes of VPA will be found and that perceived stress management ability will moderate the relationship between perceived stress and minutes of VPA.

## **Method**

### Study Design

This study used data from the College Alcohol, Sleep, and Energy Survey II (CASES II). First year undergraduate students enrolled in a large southwestern university who had participated in AlcoholEdu, an online alcohol prevention program, and who had indicated during enrollment of that program that they wished to participate in future alcohol prevention activities were invited to participate in CASES II. Invitations were sent to 5,751 incoming first-year college students. Of those invited, 844 students participated in the study, for a response rate of 14.7%. Analyses excluded participants who identified themselves as transgender ( $n = 8$ ), as gender was used as a covariate in analyses, and who had missing data on one or more of the variables studied, resulting in a total sample size of 836 first-year college students.

The CASES II survey was an online, self-report questionnaire administered near the end of participants' first year of college during the months between April and June 2011. The survey collected data regarding participants' demographics and engagement in several health behaviors. Participants consented by reading the first page of the survey, which described the purpose of the study and information regarding confidentiality, and clicking a button indicating consent, stating "agree." Participants were allowed to complete the survey in as many sittings necessary and were able to skip questions they did not wish to answer. The Institutional Review Board at the participating University approved the study procedures.

### Measures and Covariates

### *Physical activity*

Days of VPA was measured by the item (International Physical Activity Questionnaire, 2002):

Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activity activities like heavy lifting, digging, aerobics, or fast bicycling?

Response options ranged from 0 to 7 days per week. This measure was coded as a continuous variable. The International Physical Activity Questionnaire (2002) has been found to be as good as or better than other self-report measures of physical activity with respect to reliability and validity (Craig, et. al, 2003).

Minutes of VPA was measure by the item (International Physical Activity Questionnaire, 2002):

How much time did you usually spend doing vigorous physical activities on one of those days? Please enter the total minutes per day.

Response options ranged from 0 to 500 minutes per week. This measure was coded as a continuous variable. The International Physical Activity Questionnaire (2002) has been found to be as good as or better than other self-report measures of physical activity with respect to reliability and validity (Craig, et. al, 2003).

### *Stress*

Past month perceived stress was measured by the item:

On a scale from one to ten, with one being not stressed at all and ten being very stressed, how would you rate your average level of stress in the past 30 days?

Participants were given answer responses ranging from 1 to 10. This measure was coded as a continuous variable. This measure has been used in previous research (Nelson, Lust, Story, & Ehlinger, 2008a).

#### *Stress management*

Past month perceived ability to manage stress was measured by the item:

On a scale from one to ten, with one being completely ineffective and ten being completely effective, how you would rate your ability to manage stress in the past 30 days?

Participants were given answer responses ranging from 1 to 10. This measure was coded as a continuous variable. This measure has been used in previous research (Laska, Pasch, Lust, Story & Ehlinger, 2009).

#### *Covariates*

Gender (male or female) was self-reported and included as a covariate, as gender is associated with physical activity among the college student population with males reporting higher levels of physical activity (Buckworth & Nigg, 2004). BMI was calculated based on self-reported height in inches and weight in pounds by using statistical software and the formula  $(\text{lbs} * (2.2 \text{ lbs/kg})) / (\text{inches} * (2.54 \text{ cm/in}) / (100 \text{ cm/m}))^2$ . Body Mass Index (BMI) was included as a covariate, as it is associated with physical activity (Lahti-Koski, Pietinen, Heliövaara, & Vartiainen, 2002).

#### Data Analysis

Descriptive statistics were run on all variables. Skewness and kurtosis were assessed for outcome variables. All outcome variables were within the normal limits of skewness and kurtosis. Missing data for the analyses ranged from 35.8% for gender to 50.2% for days of VPA. Therefore, sample sizes for models vary slightly.

#### *Days of VPA*

Unadjusted linear regression analyses were used to determine whether there was an association between perceived stress and days of VPA. Second, adjusted linear regression models were run to determine whether an association remained between perceived stress and days of VPA after controlling for included covariates, BMI and gender. Following, regression analysis was used to determine whether the association between perceived stress and days of VPA was moderated by perceived stress management ability by testing a two-way interaction of perceived stress and perceived stress management ability on the relationship between perceived stress and VPA.

#### *Minutes of VPA*

Unadjusted linear regression analyses were used to determine whether there was an association between perceived stress and minutes of VPA. Second, adjusted linear regression models were run to determine whether an association remained between perceived stress and minutes of VPA after controlling for included covariates, BMI and gender. Following, regression analysis was used to determine whether the association between perceived stress and minutes of VPA was moderated by perceived stress management ability by testing a two-way interaction of perceived stress and perceived stress management ability on the relationship between perceived stress and VPA.

## Results

The sample consisted of first-year college students (m age=18.9), of which a majority were female (57.5%) and half were White. Fifty-six percent of the sample was aged 19 years and 95% of the sample was between 18 and 20 years (Table 1). Three quarters of the sample fell within the normal BMI range. Sixteen percent of the sample was overweight and only 5% was obese (m = 23.02) (Table 1).

Almost 40% of students reported engaging in vigorous physical activity on zero days during the past week. About a quarter of students engaged in vigorous physical activity on only one or two days in the past week. Thirty-two percent of students reported engaging in vigorous physical activity on at least three days in the past week (m = 2.0) (Table 1). Only 17% of participants engaged in at least 75 minutes of VPA per week, reaching the recommended amount of VPA, and 27.6% of participants reported engaging in 0 minutes of VPA per week (Table 1).

Twenty-eight percent of students reported that their level of stress was average or below (0-5), while 72% reported that their level of stress was above average (6-10) (m = 6.5) (Table 1). Regarding perceived stress management ability, only 15.1% of students reported that their ability to manage stress was below average (0-4), about the same proportion of students (15.4%) reported that their ability to manage stress was average (5), and 69.5% of students reported their ability to manage stress was above average (6-10) (m = 6.6).

<b>Gender</b>		<b>Percentage</b>
	Male	41.5
	Female	57.5
<b>Race/Ethnicity</b>		
	Non-Hispanic White	50.7
	Hispanic	20.0
	Non-Hispanic Black	2.5
	Asian American/Pacific Islander	21.3
	American Indian/Alaskan Native	.4
	Other	5.2
<b>Age</b>		
	18	23.7
	19	59.4
	20	12.0
	21	4.9
<b>BMI</b>		
	Underweight	3.7
	Normal	74.7
	Overweight	16.3
	Obese	5.4
		<b>Mean (SD)</b>
		<b>Range</b>
<b>Days VPA/Wk</b>		1.96 (2.01)
		0-7
<b>Minutes VPA/Wk</b>		39.78 (45.43)
		.00-500.00
<b>Perceived Stress Level</b>		6.54 (2.33)
		0-10
<b>Perceived Stress Management Ability</b>		6.62 (2.07)
		0-10

Table 1: Characteristics and descriptives of first year college students enrolled in a large southwestern U.S. university who participated in the CASES II study (n=366).

*Perceived Stress and Days of VPA*

In the unadjusted model, perceived stress was significantly associated with the number of days students engaged in VPA in the past week ( $p < .05$ ) (Table 2). For each unit increase of stress on the scale, the number of days of VPA in the past week decreased by .07 (Table 2). However, in adjusted models after gender and BMI were

entered, the association was no longer significant ( $p = .21$ ) (Table 2). Moderation of perceived stress on days of VPA by perceived stress management ability was not found ( $p = .91$ ) (Table 2).

	Unadjusted Model			Adjusted Model <sup>1</sup>			Adjusted Model <sup>2</sup>		
	B	SE	p	B	SE	p	B	SE	p
Stress	-.07	.03	.05*	-.05	.04	.22	-.02	.14	.91
Gender				-.34	.18	.06	-.33	.18	.07
BMI				-.01	.02	.84	-.01	.02	.76
Stress Management							.08	.13	.52
Stress X Stress Man.							.00	.02	.97

Table 2: The Relationship between perceived stress and days of VPA among first year college students enrolled in a large southwestern U.S. university and its moderation by perceived stress management ability ( $n=372$ ).

The unadjusted model included only perceived stress as a variable. The adjusted model<sup>1</sup> included perceived stress, gender, and BMI. The adjusted model<sup>2</sup> included perceived stress, gender, BMI, perceived stress management ability, and the moderator, perceived stress x perceived stress management ability.

\* $p$ -value  $\leq .05$

\*\* $p$ -value  $\leq .01$

\*\*\* $p$ -value  $\leq .001$

#### *Perceived Stress and minutes of VPA*

In the unadjusted model, there was a significant negative relationship between perceived stress and minutes of VPA ( $p < .05$ ) (Table 3). In the adjusted model with gender and BMI, no significant association between perceived stress and minutes of VPA was found ( $p = .41$ ) (Table 3). However, gender was significantly related to minutes of VPA in both adjusted models ( $p < .001$ ) (Table 3). Similar to days of VPA, moderation of perceived stress on minutes of VPA by perceived stress management ability was not found ( $p = .79$ ) (Table 3).



	Unadjusted Model			Adjusted Model <sup>1</sup>			Adjusted Model <sup>2</sup>		
	B	SE	p	B	SE	p	B	SE	p
Stress	-1.86	0.77	.02*	-.67	.87	.45	.70	3.18	.83
Gender				-15.01	4.15	.00***	-14.61	4.17	.00***
BMI				-.37	.50	.46	-.38	.50	.44
Stress Management							2.14	3.02	.48
Stress X Stress Man.							-.11	.40	.79

Table 3: The Relationship between perceived stress and minutes of VPA among first year college students enrolled in a large southwestern U.S. university and its moderation by perceived stress management ability (n=379).

The unadjusted model included only perceived stress as a variable. The adjusted model<sup>1</sup> included perceived stress, gender, and BMI. The adjusted<sup>2</sup> model included perceived stress, gender, BMI, perceived stress management ability, and the moderator, perceived stress x perceived stress management ability.

\*p-value  $\leq$  .05

\*\*p-value  $\leq$  .01

\*\*\*p-value  $\leq$  .001

## **Discussion**

Obesity remains a significant public health issue. Emerging adulthood is a crucial time period in the development of obesity, as the rate of obesity increases drastically from adolescence to adulthood and physical activity sharply declines. Given that first-year college students fall within emerging adulthood and experience high levels of stress, and stress has been found to be a barrier to physical activity (Stetson, Rahn, Dubbert, Wilner, & Mercury, M. G., 1997), they are a fitting population for which to focus to better understand the relationship between stress and physical activity.

While this study did find support for the hypothesis that perceived stress would be negatively associated with both minutes and days of VPA per week, once gender and BMI were taken into account, the association between perceived stress and VPA disappeared, indicating that there was no association between perceived stress and days or minutes of VPA per week over and above gender and BMI. Additionally, contrary to hypotheses, perceived stress management ability did not significantly moderate the relationship between perceived stress and days or minutes of VPA per week. Therefore, the relationship between perceived stress and VPA does not differ by college students' perceived stress management ability.

The findings of this study suggest that stress may be a barrier to VPA for first-year college students. It is possible that stress is associated with time-pressure (Stetson, et. al, 1997) and that during time-pressured situations, first-year college students eliminate VPA to save the time that would have been used for VPA for other tasks. Additionally, first-year college students may have lower self-efficacy for VPA when

stress is high (Stetson, et. al., 1997). More importantly, however, is the finding that being female may have an even stronger negative association with VPA than does perceived stress.

Gender was a significant predictor of minutes of VPA in both adjusted models and approached significance as a predictor of days of VPA in both adjusted models. Gender explained more of the variance in participants' minutes and days of VPA than both perceived stress and BMI in the adjusted<sup>1</sup> model. Additionally, the vast majority of the sample for the current study was within the normal BMI range. These results suggest that gender has a greater association with VPA than perceived stress, and that female emerging adults are even more vulnerable to low levels of VPA than their male counterparts. Future research should further examine patterns and correlates of VPA and of meeting physical activity guidelines among emerging adults by gender. Research in this vein may provide implications for physical activity intervention tailored to gender.

The results from the current study are inconsistent with previous work by Steptoe and colleagues (1996). They examined whether stress from upcoming exams reduced VPA duration, which is similar to the current study's construct of minutes of VPA, and number of sessions of VPA, which is similar to this study's construct of days of VPA . Steptoe and colleagues (1996) used a prospective design with a comparison group. One group was "exam-stressed" while the comparison group was not "exam-stressed" and VPA was assessed at two points in time. They found that among the exam-stressed group, there was not a reduction in the number of sessions of VPA, but there was a reduction in the duration of the VPA sessions. Their findings suggest that students who are

academically stressed still participated in VPA for a similar number of sessions per week, but reduced the duration of their VPA sessions. While the current study did find significant associations between perceived stress and both days and minutes of VPA, these associations were no longer significant after adjusting for gender and BMI. Steptoe and colleagues did not control for the effect of gender on VPA. This is notable, because it may help explain the inconsistency in findings between their study and the current study and highlights the significance of gender in VPA. It is also possible that Steptoe and colleagues (1996) were better able to detect a relationship between stress and duration of VPA due to their study design and use of a comparison group. Additionally, the reduced duration of VPA among college students found in the study conducted by Steptoe and colleagues may be a result of increased time students needed to study for upcoming exams and not solely due to stress. The current study and the study conducted by Steptoe and colleagues (1997) found similar rates of days of VPA at baseline ( $M = 2.21$ ) as the current study ( $M = 2.0$ ), but the current study found much lower rates of minutes of VPA ( $M = 39.8$ ) than did Steptoe and colleagues (1997) at baseline ( $M =$  approximately 350). The higher initial duration of VPA session may also help explain why Steptoe and colleagues (1997) found a significant reduction in duration of VPA in the academically stressed group while the current study found no association for perceived stress and minutes of VPA taking into account gender and BMI.

Because the findings of the current study are inconsistent with previous studies on the association between stress and physical activity and because previous research has rarely examined the impact of stress on physical activity among emerging adults, these

findings imply that the relationship between perceived stress and VPA may operate differently among emerging adults as compared to those in other developmental stages with respect to VPA. Several characteristics of emerging adulthood make this period distinct from other stages of the life course (Nelson, et. al, 2008). For example, emerging adults engage in more behavior and identity exploration (Nelson, et. al, 2008) and spend more time alone than do older adults (Larsen, 1990). Characteristics which make emerging adulthood a unique stage of the life course may also make this population unique with respect to the relationship between perceived stress and VPA and would potentially partially explain why the current study did not find evidence that perceived stress is associated with VPA while previous studies with samples of adults in older age groups have found a negative association between stress and physical activity (Lutz, Lochbaum, Lanning, Stinson, & Brewer, 2007; Stetson, Rahn, Dubbert, Wilner, & Mercury, 1997).

Consistent with previous research (NCHA, 2011), this study found that perceived stress levels among first-year college students were high, with almost three quarters of participants perceiving that the level of stress they were experiencing was above average. By comparison, only 19% of students reported that their level of stress was below average. The high levels of perceived stress among first year college students are concerning, considering the negative health consequences of stress (Thoits, 2010). Future research should focus on factors associated with stress levels in an aim to determine causes of stress among first-year college students and possible intervention strategies to prevent or reduce stress among this population.

Surprisingly, this study found that the majority, almost 70%, of students perceived that their ability to manage stress was above average. Little research has examined perceived stress management ability in college students, or in other populations, so no comparisons with previous research can be made. Future research concerning perceived stress management ability may benefit from the use of more multidimensional measures of perceived stress management ability, as the measure for the current study used only one item to measure this construct.

Consistent with previous research (Gordon-Larsen, Nelson, & Popkin, 2004; NCHA, 2011), this study found that VPA levels among first year college students are low. Only 17% of students reported engaging in the minimum 75 minutes of VPA per week recommended by the 2008 Physical Activity Guidelines for Americans and 40% of students participated in VPA on zero days per week. However, this study did not assess moderate physical activity (MPA). Because the 2008 Physical Activity Guidelines for Americans recommends either 75 minutes of VPA, 150 minutes of MPA, or some equivalent combination of the two, we cannot assess the whole picture of physical activity for this sample, and thus can conclude nothing about whether this sample achieved or failed to achieve adequate physical activity. Further, conclusions regarding the impact of perceived stress on physical activity as a whole or on meeting physical activity guidelines among first-year college students also cannot be made from the results of this study. Future research in this area should use composite measures of MPA and VPA to assess physical activity as a whole. Additionally, it is possible that the relationship between perceived stress and MPA may be different from that of perceived

stress and VPA among this population. VPA and MPA are very different constructs and stress may be differentially associated with them. For instance, individuals may engage in MPA as part of daily life, without making an active effort to achieve MPA. For example, students may achieve adequate MPA by walking to and from class, but may alternatively have to actively try to achieve VPA through a planned VPA session. Additionally, future research should examine the impact of perceived stress on MPA as well and on meeting physical activity guidelines in order to determine the impact of perceived stress on physical activity more broadly.

While 40% of participants reported that they engaged in VPA on zero days per week, only 27.6% of participants reported that they engaged in zero minutes of VPA per week. The item measuring days of VPA asked participants to only report days on which they engaged in VPA in durations of 10 minutes or more. These results, therefore, could either be a result of participants underreporting the number of days in which they engaged in VPA due to poor recall or of participants engaging in bouts of VPA of durations less than 10 minutes. Future research on VPA should account for the possibility that participants may under-report VPA sessions due to poor recall.

In conclusion, the current study found that perceived stress was associated with days and minutes of past week VPA, but that after accounting for gender and BMI, there was no association. Future research should explore why perceived stress may be a barrier to VPA among first-year college students. Because the vast majority of the sample was within the normal range for BMI, these findings indicate that perceived stress may be a barrier to VPA, but that gender is even more important in VPA participation than is

perceived stress. Future research should explore the role of gender in VPA and meeting physical activity guidelines. Moderation of the relationship between perceived stress and VPA by perceived stress management ability was not found. Future research should use a more multidimensional measure of perceived stress management ability.

#### *Limitations and Future Directions*

The current study has a number of limitations. First, this study used a cross-sectional design which does not allow for the determination of direct effects of perceived stress on VPA. Therefore assumptions of causality cannot be made. For example, analyses on the data used in this study cannot determine whether stress causes changes in VPA. Rather, only a relationship between the two factors can be determined. A second limitation of this study is that self-report data of VPA may not be an accurate measure of VPA. Research has found that for physical activity overall, adults both over-report and underreport physical activity on self-report measures (Prince, et. al, 2008). Thus, the amount of VPA reported by participants in this study may not be an accurate reflection of VPA among this population. Future research on VPA should consider objective measures of VPA, such as accelerometry. The Computer Science Application monitor, one brand of accelerometer, has acceptable reliability for most research purposes (Welk, Schaben, & Morrow, 2004). Thirdly, the measure of perceived stress management ability used in the current study was comprised of only one item. Future studies involving stress management ability may benefit from a more multidimensional measure of perceived stress management ability.



Finally, the broad aim of this study was to examine the impact of stress on VPA and test the potential moderating role of stress management ability among emerging adults, but the sample used in this study included only first-year college students. Findings of the current study may not generalize to emerging adults who do not attend college or college students who are not first-year students. Emerging adults who do not attend college may differ from emerging adults who attend college with respect to health behaviors. As many studies lament, little is known about emerging adults who do not attend college, because research on emerging adults have often used college students as a readily available source participants (William T. Grant Foundation Commission on Work, Family, and Citizenship, 1988). However, some research has found evidence that emerging adults who do not attend college differ from those who do with respect to some health behaviors, such as cigarette and marijuana use (White, Labouvie, & Papadaratsakis, 2005). Therefore, future research on stress and physical activity should include emerging adults who do not attend college as well as those who do.

The current study adds to previous research on the impact of stress on physical activity. While this study found preliminary evidence that perceived stress is negatively associated with VPA among first-year college students, future research should examine how perceived stress may serve as a barrier to VPA among this population. Because this association was no longer significant after accounting for gender and BMI, this study highlights the need for future research to examine the role of gender in emerging adults' participation in VPA, as well as its possible role in the relationship between perceived stress and VPA. These findings also suggest that female emerging adults may be more

vulnerable to low levels of VPA and implications suggest physical activity intervention targeted towards female college students.

The body of research concerning the relationship between stress and physical activity is still in its infancy. The current study contributes this area of research, as it is one of few studies that has examined the relationship between perceived stress and VPA among emerging adults. This study is also one of the first studies to examine the role of stress management ability in the relationship between perceived stress and VPA. Findings from this study can be used to inform and direct future research in this area.

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