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RELATIONS OF PHYSICAL ACTIVITY AND STRESS VULNERABILITY IN UNIVERSITY STUDENTS

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Summary.—The purpose of this study was to examine association between leisure-time physical activity and stress vulnerability among college students. A modified survey including physical activity and stress vulnerability questions were administered to 120 college students. Forty percent of the sample fell in physically inactive category, with less than 150 minutes of physical activity each week. Twenty-one percent of sample showed symptoms of depression or anxiety. A standard linear regression analysis revealed a significant association between leisure-time physical activity and depression \((r = -0.55, p < .01)\). In addition, social network was found to have a significant correlation with leisure-time physical activity \((r = 0.58, p < .001)\). It also found that walking, jogging, and running were physical activities in which college students engaged most.
Depression and anxiety due to unfavorable stress are negative emotional states associated with feelings of worry and negative thinking; interfering with people’s daily life (Seligman, Walker, & Rosenhan, 2001). Health professionals have demonstrated serious concern over depression and anxiety because they may have a negative impact on people’s physical and mental health (American College Health Association, 2006; Andrew & Wilding, 2004; Weitzman, 2004). College has been considered a period in which depression and anxiety can easily occur, as this is a transition period from childhood to young adult, and college students during this period may encounter myriad problems (McNamara, 2000).

According to American College Health Association (ACHA, 2006), college students were more susceptible to stress as a consequence of maturational changes and entering the new social community or new life to which they had to accommodate and adjust themselves. For many college students, going to college might be the first time away from home, handling difficult tasks including, time management and courses selections. Additionally, a large portion of college students have to work in order to subsidize tuition while struggling to maintain academic success, while advanced college students might face difficulty with career choices and job search, especially when economic conditions are down. Andrew & Wilding (2004) reported that college students frequently experienced problems such as financial difficulties, poor academic performance, and stressful interpersonal relationships, which made them particularly vulnerable to anxiety and depression. Further, it was found that college students with a high level of depression or anxiety were more likely to continuously have these problems later in life; and that students who suffered from depression or anxiety may be at a higher risk for further health complications later in life (Zivin, Eisenberg, Gollust, & Golberstein, 2009).
According to data collected by Behavioral Risk Factor Surveillance System in 2006, the prevalence of depression and anxiety was the highest (12.5%) among youth, aged 18-24, compared with other age groups. This phenomenon has raised an increasing concern of college students’ mental health (O’Neal, Dunn, & Martinsen, 2000). While a certain level of stress may result in improved performance, too much stress can adversely affect people’s physical and mental health (Schneiderman, Ironson, & Siegel, 2005). Individuals with depression or anxiety are also at a higher risk of developing cardiovascular disease than those without it (Rowan, Haas, Campbell, Maclean, & Davidson, 2005). In addition, depression and anxiety could lead to alcohol abuse and other risky behaviors (Weitzman, 2004), and could possibly make people more vulnerable to suicidal ideation (American College Health Association, 2006).

Meanwhile, a substantial body of research has showed beneficial effects of physical activity on depression and anxiety. A large-sample study reported a significantly inverse relationship between leisure time physical activity and depression symptoms among adolescents who participated in a school-based, group-randomized trial study to alter cancer-related dietary risk behaviors in young adolescents (Motl, Birnbaum, Kubik, & Dishman, 2004). In another study, Goodwin (2003) discovered the effect of physical activity on reducing people’s depression level. Similar findings were reported in other studies as well (Motl, Birnbaum, Kubik, & Dishman, 2004; Paluska & Schwenk, 2000). In addition, after a thorough literature review, Martinsen (2008) recently reported the promising results of the effect exercise has on decreasing depression and anxiety levels.

While physical activity has potential effects on reducing stress, literature suggests that half of university students exercise well below the recommended level (150 minutes weekly) of physical activity (Burke, Carron, & Eys, 2006; Irwin, 2004), and that relatively few studies have
related exercise to decreasing depression among the college population in the United States. Skirka (2000) investigated the effects of sports participation on psychological health among a group of 270 college athletes and non-athletes. An inverse correlation between perceived stress and sport participation was noted. Another study examined the effects of leisure time physical activity on stress management in a sample of 135 undergraduate psychology and kinesiology students; it was found that participants‘ level of stress was significantly reduced with participation in physical activity (Carmack, Boudreaux, Amaral-Melendez, Brantley, & de Moor, 1999). However, a study \( n = 814 \) conducted in Southern California reported no significant association between perceived stress and level of physical activity among college students (Nguyen-Michel, Unger, Hamilton, & Spruijt-Metz, 2006), and the authors claimed that their findings might be affected by some limitations such as the selected survey instrument.

To better understand the relationship between physical activity and unfavorable stress among college students, it is desirable to conduct additional research. Therefore, the purpose of this study was to further examine the correlation between physical activity participation and stress level among college students.

**Method**

**Participants**

Potential participants were a convenience sample of 135 students from five classes in three universities. 120 of the students sampled (age 18-30; 55 female, 65 male) completed the survey, yielding an 89% response rate. Of the 120 participants, 26% were freshmen \( n = 31 \), 25% were sophomores \( n = 30 \), 26% were juniors \( n = 31 \), 19% were seniors \( n = 23 \), and 4% were graduate students \( n = 5 \). As for race distribution, 76% were Caucasian \( n = 93 \), 7% were
African American ($n = 8$), 8% were Asian American ($n = 10$), 2% were Hispanic ($n = 2$), 0.8% were American Indian, and the remaining 5% identified as other.

**Measures**

A three-part questionnaire was used in this study. The first section contained demographic information including age, gender, grade levels, ethnical background, and academic performance (GPA). The second asked the participants to recall exercise frequency, duration, and type of physical activity they engaged in during a typical week in the past three months. All questions had a multiple choice format, except the type of physical activity each participant engaged in. For example, the item for exercise duration asked: “When you exercised, on average, how many minutes did you engage in the specific activity?” the participants chose one of the following choices, 30 minutes or less, 31-60 minutes, 61-90 minutes, or more than 90 minutes.

Total weekly physical activity time in minutes was calculated by having frequency of weekly physical activity multiplied by the average duration of exercise time. As for type of physical activity, participants were required to write down the specific activities they engaged in during a typical week in the past three months. In addition, physical activity was categorized into three levels based on professional recommendations (Burke, Carron, & Eys, 2006; Irwin, 2004); that is, low (less than 150 minutes weekly), medium (150-300 minutes), and high (more than 300 minutes).

The third part was based on a stress vulnerability scale, which was modified from Hoeger and Hoeger’s Depression Anxiety Stress Scale (2005). This scale contained 25 four-point items with 1 indicating strongly disagree and 4 indicating strongly agree, summing to 100 points. The 25 items covered four subcategories of the stress vulnerability scale, health (40 points), social network (16 points), time management (20 points), and nurturance (24 points). A composite
score of 60 or higher out of the 100 points indicated a high level of stress vulnerability. In the present study, coefficient alphas for the four subcategories were all greater than .70, and a split-half coefficient of .85 was obtained, indicating acceptable internal consistency of the stress vulnerability scale.

Procedure

After obtaining the approval to conduct the study from the institutional review board of human subjects, the modified questionnaire was administered to 30 university students at a university located in the Northeast region of the United States as a pilot survey in fall 2007. The questionnaire was revised based on the feedback of the pilot version. These changes included removing difficult sentences and revising or removing items lacking internal consistency. After revising, the final version of the questionnaire was administered to 120 students from three universities in fall 2008.

Data Analyses

All statistical analysis was done through the SPSS Version 13.0 for Windows software package. Descriptive statistics analysis was conducted to describe the characteristics of participants (gender, age, grade levels, and ethnical background), physical activity levels, composite stress vulnerability scores, and scores of the four subcategories of stress vulnerability (health, social network, time management, and nurturance). The composite stress vulnerability scores were converted into five levels based on Hoeger and Hoeger’ scoring protocol for stress vulnerability: excellent (0-30), good (31-40), average (41-50), vulnerable to stress (51-60), and high vulnerability to stress (≥61). Standard linear regression analyses were used to test the strength of association between physical activity level and stress vulnerability, each of the four subcategories of stress vulnerability, and academic performance. The independent samples t-test
was used to examine differences in physical activity levels, perceived stress vulnerability, and each of the four subcategories of the stress vulnerability between male and female college students. Alpha level was set at $p < 0.05$ for all the inferential tests.

**Results**

One hundred and twenty university students (55 female and 65 males) completed the questionnaire. Table 1 presents selected demographic characteristics of the sample (insert Table 1 here). A standard linear regression analysis (Figure 1) revealed a significantly inverse correlation between leisure time physical activity and stress vulnerability ($r = -0.55, p < 0.01$). In addition, of the four subcategories (health, social network, time management, and nurturance) of the stress vulnerability, only social network was found to have a significant correlation with leisure-time physical activity ($r = 0.58, p < .001$) (Figure 2). The mean stress vulnerability score was 51 with the range from 30 to 71. Twenty-one percent of samples ($n = 25$) showed significant symptoms of depression or anxiety, with stress vulnerability scores that were more than 60 (out of 100). Out of 27 minority respondents, 5 (18.5%) had stress vulnerability score higher than 60, while only 12 out of 93 Caucasian respondents or 12.9% of them scored above that level. This difference, however, is not statistically significant at the 0.05 level. In addition, no significant relationship between leisure-time physical activity and academic performance was identified ($p > 0.05$).

In terms of physical activity level, forty percent of the sample ($n = 48$) fell into the physically inactive category, with less than 150-minutes of physical activity each week, although most of them indicated trying to incorporate physical activity into their daily schedule. Sixty percent of the samples ($n = 72$) exercised three times or more during a typical week during the past three months, and 59% respondents ($n = 71$) were using exercise to cope stress. With
regards to type of physical activity engaged, most participants \((n = 79, 65.3\%)\) reported jogging and running, followed by walking \((n = 22, 18.2\%)\). Other physical activities engaged with relatively more participants were ball games (baseball, softball, basketball, or soccer; \(n = 9; 7.3\%\)), bicycling \((n = 6, 4.95\%)\), badminton \((n = 3, 2.48\%)\), and swimming \((n = 2, 1.65\%)\).

With respect to gender differences (Table 2), male college students reported significantly higher weekly physical activity minutes \((M = 265.8, SD = 165.4)\) than female college students did \((M = 174.7, SD = 130.1)\), with \(t_{(118)} = -3.38\) and \(p < 0.01\). However, no significant gender differences were found in stress vulnerability or any of the four subcategories of stress vulnerability (health, social network, time management, and nurturance).

**Discussion**

The main purpose of this study was to examine how physical activity was associated with stress vulnerability in college students. We also examined how physical activity was associated with each of the four subcategories of the stress vulnerability and academic performance. In addition, participants’ physical activity level and gender differences in physical activity, stress vulnerability, and each of the four subcategories of stress vulnerability were examined.

It was found in the study that college students’ physical activity level was inversely related to their perceived stress vulnerability, and the result is consistent with the finding in previous studies (Skirka, 2000; Carmack, Boudreaux, Amaral-Melendez, Brantley, & de Moor, 1999). This demonstrates again that physical activity participation may be an effect strategy in reducing college students’ stress level, hence alleviating their depression and anxiety level as well. Also, it was found that male college students were more physically active than their female counterpart, but there was no significant difference in term of stress vulnerability between genders, and this result is somewhat inconsistent with previous research. Two previous studies
(Angst et al., 2004; Matud, 2004) reported higher level of physical activity and lower level of stress and depression on the part of male college students compared with female students, which seems logical, given that physical activity is frequently found to be inversely related to stress vulnerability. The reason for the discrepancy could be complicated and multiple factors that impact stress vulnerability. While physical activity is generally suggested as a strategy to deal with stress and depression, it is not an absolute solution; many other factors also play a role in stress and depression. For example, One’s financial situation and self-efficiency can be related to stress vulnerability (Cohen, Gottlieb, & Underwood, 2000). Both are important predictors of depression and anxiety (Krieger, 2001). These two factors, however, were not measured in this study but may contribute to the stress vulnerability level of the sample in this study.

The present study revealed that walking, jogging, and running were physical activities engaged most by college students. All those activities were aerobic activities with moderate to vigorous intensity. This result regarding physical activity type is consistent with conclusions of Megan, Ball and Salmon’s (2008) review that all physical activity improves global mental health, whereas aerobic activity is more dominant in alleviating symptoms of depression in the adult population. Walking, jogging, and running are also lifetime activities that can be carried over into old age, and highly suggested in physical activity recommendations (Gallahue & Ozmun, 2006).

However, forty percent of the sample (n = 48) fell into the physically inactive category, with less than 150-minutes of physical activity each week. There was also a high percentage of stress vulnerability (21%) among college students, and this finding is in accordance with that of a web-based survey (Eisenberg, Gollust, Golberstein, & Hefner, 2007) indicating that 15.6% undergraduate student and 13% graduate students had positive sign for anxiety and depression.
Thus, increasing physical activity levels and reducing stress vulnerability on the part of college students will be a continuous focus in the future. Given that physical activity levels in general are considered as factors to alleviate stress levels, more strategies facilitating college students’ physical activity participation needs to be identified and implemented. Based on the results of this study, one’s social network is significantly correlated with their physical activity level, which is consistent with Cohen et al. (2000) statement that social support could directly contribute to health behaviors such as physical activity. Thus, strategies, including organizing walking clubs or jogging/running clubs in universities and colleges may contribute to physical activity levels of college students. These clubs provide social support/network and physical activity opportunities as well.

In summary, the results of the present study indicate that physical activity is inversely correlated to perceived stress and depression, and one’s social network is positively related to physical activity involvement. The results also indicate that low physical activity level and a high prevalence of stress is a continuing issue among college students. Given the considerable evidence that physical activity may alleviate stress, it is suggested to increase college students’ physical activity level as a means of reducing their stress level.

Some limitations associated with the study need to be mentioned as well. The sample in this study consisted of college students from only three universities, majoring in kinesiology, or registered in physical education classes, which might not be representative of the typical college student population in the US. Also, the physical activity survey involved a three-month physical activity recall, which was very challenging and might result in inaccurate data. Further, the study was with a cross-sectional design, and data collection at several time points may provide a more
comprehensive picture of the issue. Hence, more research with better design is needed in the future.
References


Table 1.

**Distribution of College Students’ Demographic Characteristics**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Female (n = 55)</th>
<th>Male (n = 65)</th>
<th>Total (N = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td></td>
<td>32.7</td>
<td>20.0</td>
<td>25.8</td>
</tr>
<tr>
<td>Sophomore</td>
<td></td>
<td>23.6</td>
<td>26.2</td>
<td>25.0</td>
</tr>
<tr>
<td>Junior</td>
<td></td>
<td>23.6</td>
<td>27.7</td>
<td>25.8</td>
</tr>
<tr>
<td>Senior</td>
<td></td>
<td>16.4</td>
<td>21.5</td>
<td>19.2</td>
</tr>
<tr>
<td>Graduate student</td>
<td></td>
<td>3.6</td>
<td>4.6</td>
<td>4.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Percentage</th>
<th>Female (n = 55)</th>
<th>Male (n = 65)</th>
<th>Total (N = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-20</td>
<td></td>
<td>45.5</td>
<td>33.8</td>
<td>39.2</td>
</tr>
<tr>
<td>20-25</td>
<td></td>
<td>54.5</td>
<td>64.6</td>
<td>60.0</td>
</tr>
<tr>
<td>26-30</td>
<td></td>
<td>0.0</td>
<td>1.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race/ethnicity</th>
<th>Percentage</th>
<th>Female (n = 55)</th>
<th>Male (n = 65)</th>
<th>Total (N = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td></td>
<td>9.1</td>
<td>4.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Caucasian</td>
<td></td>
<td>72.7</td>
<td>81.5</td>
<td>77.5</td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td>9.1</td>
<td>7.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Spanish/Latino</td>
<td></td>
<td>1.8</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>American Indian</td>
<td></td>
<td>1.8</td>
<td>0.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>5.5</td>
<td>4.6</td>
<td>5.0</td>
</tr>
</tbody>
</table>
Table 2.

Gender Differences in Weekly Physical Activity Minutes, Stress Vulnerability, and Each of the Four Subcategories of Stress Vulnerability

<table>
<thead>
<tr>
<th></th>
<th>Female (n = 55)</th>
<th>Male (n = 65)</th>
<th>Independent t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Weekly physical activity minutes</td>
<td>174.7</td>
<td>130.1</td>
<td>265.8</td>
</tr>
<tr>
<td>Stress vulnerability</td>
<td>52.3</td>
<td>9.8</td>
<td>50.5</td>
</tr>
<tr>
<td>Health</td>
<td>36.9</td>
<td>5.0</td>
<td>36.7</td>
</tr>
<tr>
<td>Social network</td>
<td>11.2</td>
<td>3.4</td>
<td>12.7</td>
</tr>
<tr>
<td>Time management</td>
<td>13.0</td>
<td>2.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Nurturance</td>
<td>18.0</td>
<td>2.3</td>
<td>17.7</td>
</tr>
</tbody>
</table>

Note. The composite score for stress vulnerability is 100 points. The total score is 40 points for health, 16 points for social network, 20 points for time management, and 24 points for nurturance.

* Gender difference is significant at the 0.01 level (2-tailed).
Figure 1. Linear correlation between physical activity and stress vulnerability
Figure 2. Linear correlation between social support and physical activity