

Exercise and academic performance among nursing and kinesiology students at US colleges

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ABSTRACT

Context: Lack of physical activity is a contributor to the obesity epidemic and is speculated to relate to reduced academic performance; however, this link has yet to be examined within the college population. **Aims:** The purpose of this study in a group of undergraduate students, was to determine if aerobic exercise activity was related to academic performance. **Materials and Methods:** The participants for this study included 740 students at multiple universities enrolled in nursing and kinesiology studies. The participants completed the Leisure and Physical Activity Questionnaire. **Results:** Pearson's χ^2 analysis revealed differences in grade point average with aerobic activity ($\chi^2 = 44.29$, $P \leq 0.001$) as well as a trend toward differences in grade point average with weightlifting activity ($\chi^2 = 22.69$, $P = 0.61$). **Conclusions:** Based on these findings it can be suggested that college students engage in greater aerobic exercise.

Key words: Academic performance, allied health students, nursing students, physical activity

INTRODUCTION

Lack of physical activity is a trend that is expanding across age brackets in the United States. In older adults, obesity and lack of physical activity have been linked to numerous medical complications and cognitive decline.^[1] However, the trends in physical activity among younger adults remain under-represented in the literature. This is particularly relevant, given that studies have shown that college students, on an average, do not accumulate the recommended amount

of physical activity for an adult and 60% of college students are unaware that adults should exercise five days a week for 30 minutes at moderate intensities.^[2]

In general, there is a lack of physical activity^[3] among US college students. These students are also engaged in sedentary activities,^[4,5] which reduce the available time for health promoting behaviors and academic pursuits. Sedentary activity for students comes in many forms, but a good amount of these activities fall into the 'square tube' category, such as, watching TV, surfing the Internet, and playing video games. The amount of time that college students spend on the Internet has been shown to relate to reduced academic performance.^[4] It has also been demonstrated that the time spent by college students in communicating through electronic media is related to the higher levels of distractibility for academic tasks.^[6] Evidence also exists that among high school-aged students, time spent playing videogames is negatively correlated with academic performance.^[5] However, a study that examined a community college population did not report a relationship between videogames and academic markers.^[7] It would appear that sedentary activity can impact academic performance; however, the link between academic performance and video game use requires further study in the collegiate population.

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Access this article online	
Quick Response Code:	Website: www.jehp.net
	DOI: 10.4103/2277-9531.127560

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This article may be cited as: Bellar D, Judge LW, Petersen J, Bellar A, Bryan CL. Exercise and academic performance among nursing and kinesiology students at US colleges. *J Edu Health Promot* 2014;3:9.

A recent study has demonstrated acute and chronic effects of aerobic exercise on cognitive performance. Best^[8] reported in a recent review of the research on aerobic exercise and children's executive function, that cognitively engaging aerobic exercise seemed to be linked to higher levels of executive function. Tomporowski *et al.*^[9] also reported a similar relationship between cognition and exercise among children. However, until recently there was a lack of plausible mechanistic understanding of these reported relationships.

One initial hypothesis suggested that increased cerebral oxygenation due to aerobic exercise was the reason for the increase reported in cognitive function. A recent study by Ando *et al.*^[10] tested the hypothesis that increased cerebral oxygenation may account for the differences seen in cognition, post exercise: However, the results demonstrated improvements in cognitive function that were judged to be independent of cerebral oxygenation. A second possible mechanism behind the changes associated with aerobic exercise was centered on exercise-induced increases in the Brain Derived Neurotrophic Factor (BDNF). Griffin *et al.*^[11] examined the effects of acute and chronic cycling exercise and found that the exercise-induced changes in BDNF and in the hippocampal function improved the performance in memory recall. The finding by Griffin *et al.*,^[11] mirrors findings based on animal models^[12] that reported a similar relationship between exercise, increased BDNF, and increased hippocampal plasticity. Importantly, Griffin *et al.*^[11] also reported a chronic effect of exercise, after five weeks, where cognitive function and BDNF responses to exercise were increased. This last finding lends credence to the cross-sectional reports that increased levels of aerobic activity or physical activity are related to better cognitive function or academic performance.^[8,9,13,14]

There are numerous studies that have examined this trend in a cross-sectional manner with high school-aged students and younger ones too.^[8,9,13,14] However, there is only one study to date that has examined this in a group of college students.^[14] This study has been done in a small group ($n = 224$) of nursing students in Kuwait and it has not reported a significant relationship. However, given the many variables that contribute to cognitive function it is likely that in a small cohort study, the statistical power would not be sufficient to reveal any relationships.

The present investigations ought to determine if the aerobic activity level of college students was associated with higher grade point averages among the Nursing and Kinesiology undergraduate students, who would likely be heavily involved in health promotion and education in future careers. The research questions to be addressed included: Determining the differences in students' grade point average by both aerobic and weightlifting activities, and finally, based on the strength of the relationship, making recommendations for aerobic exercise habits for college students.

MATERIALS AND METHODS

Participants

The present investigation was reviewed and approved by the Institutional Review Board at the University of Louisiana at Lafayette. The participants gave written informed consent prior to completing the Leisure and Physical Activity Questionnaire (LPA), and were free to withdraw at any time after commencing the study. Data was collected during the spring semester, ensuring that the freshmen surveyed had achieved a grade point average (had been enrolled long enough to have earned quality points during a previous semester). Students who enrolled in spring, who could not report a grade point average, were excluded from the data analysis.

Leisure and physical activity questionnaire

Leisure and Physical Activity (LPA) is a short self-report instrument designed to assess a college student's sedentary/non-sedentary activity, class rank, gender, and grade point average. The demographic variables are recorded as follows: Class rank as freshman, sophomore, junior or senior, gender as female or male, and grade point average between 0.0 and 4.0. Sedentary activity types assessed are time spent in typing/schoolwork, web surfing/entertainment, video gaming. Each sedentary/non-sedentary activity type classification has further descriptors for clarification: Web surfing/entertainment included (television, facebook, myspace, etc.) and video gaming included (XBox, Xbox 360, Playstation, etc.). These activities have been assessed for frequency (0-2 days, 3-5 days, 6-7 days) per week as well as duration per about 0-15 minutes, 16-30 minutes, greater than 30 minutes. Each frequency and duration has been assigned a score of one to three points for each of the possible responses. Grade point average has been assessed via predetermined ranges of answers (0-0.99, 1-1.99, 2-2.99, 3-3.99, 4.0 or above). Aerobic exercise (running, walking, biking, aerobics classes, etc.) and weightlifting (machine, freeweight, etc.) have been assessed in a similar fashion for frequency and duration.

The total scores for each item assessed were computed as the sum of the frequency and duration scores. This instrument demonstrated a low item to total correlations ($r < 0.20$), suggesting that the items were measuring different constructs as was the intention when the survey was designed. In pilot testing, the weightlifting total score demonstrated a significant correlation ($r > 0.80$, $P < 0.05$, $n = 58$) to the criterion measure hand-grip strength, assessed via a hand grip dynamometer (Jamar Hand Dynamometer, Sammons Prestons Bolingbrook, IL). Similar results were found in another pilot study for the aerobic total score and VO₂ max ($r > 0.60$, $P < 0.05$, $n = 12$) assessed via a graded exercise test, utilizing a modern metabolic cart (ParvoMedics TrueOne 2400, ParvoMedics, Sandy, UT). Both the weightlifting and aerobic total scores were not significantly different pre- to post-test in a large sample test-retest reliability study ($n = 389$, $P > 0.05$) that examined the stability of the survey after a one-month time period. Histograms of the distribution of data collected for variables of interest via the LPA survey can be seen in Figures 1-3.

Statistical analysis

Data were analyzed for the relationship between the non-parametric correlation analysis and Pearson's Chi-square test due to the ordinal and interval nature of the survey data. All analyses were conducted with a modern statistical software package (IBM Corp, SPSS version 20.0, Armonk, NY). Statistical significance was set *a priori* at a .05 alpha level.

RESULTS

Participants in the present investigation (age: 21.2 ± 4.7 years, female $n = 317$, male $n = 423$, freshman 16.5%, sophomore 24.4%, junior 26.0%, senior 28.3%, and post-baccalaureate 3.1%) were 740 students enrolled in undergraduate course studies in either Nursing or Kinesiology (Health Promotion, Exercise Science, Sport Management) at the Southern and Midwestern Universities (Southern 34.2%, Midwestern 65.8%). The data demonstrated expected trends for distribution, as the mean response to grade point average demonstrated that a majority of student's reported grade point averages in the range of 3-3.99, with the second highest response being 2-2.99. The aerobic activity total score demonstrated a normal distribution, with only a slight skew toward the higher scale scores, whereas, the weightlifting activity demonstrated a bimodal distribution. Gender demonstrated a significant non-parametric correlation to the total weightlifting activity ($P < .05$). Male students reported spending more time engaged in weightlifting exercise.

Pearson's χ^2 analysis revealed differences in grade point average with aerobic activity ($\chi^2 = 44.29, P \leq 0.001$), with higher levels of aerobic activity being associated with higher grade point averages [Figure 4]. A non-significant trend was observed toward differences in grade point average with weightlifting activity ($\chi^2 = 22.69, P = 0.61$), with higher weightlifting activity being associated with lower grade point averages [Figure 5].

Differences in reported grade point average were also noted by reported time spent typing and completing schoolwork ($\chi^2 = 62.40, P \leq 0.001$), with higher reported amounts of studying being associated with higher GPAs. In addition, differences in GPA were found for reported time spent video gaming, with higher amounts of video gaming being associated with lower GPAs ($\chi^2 = 57.09, P \leq 0.001$).

DISCUSSION

The present investigation fills a gap in the literature by expanding findings among elementary, middle, and high school students in regard to the association of physical activity and academic performance. Fox *et al.*^[13] reported that among a large cohort of middle and high school students, participation in team sports was associated with higher GPAs. Laure and Binsinger^[15] reported a similar finding in a large cohort of French students. Stevens *et al.*^[16] reported that physical activity was associated with higher achievement scores in both mathematics and reading. Although in these

investigations physical activity was only one of the many correlates to academic performance, nonetheless increased

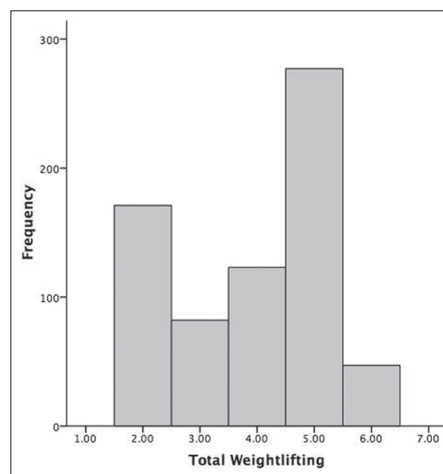


Figure 1: Histogram of total weightlifting activity. Scores range from 0 for no activity to 6 the highest possible response for weightlifting activity

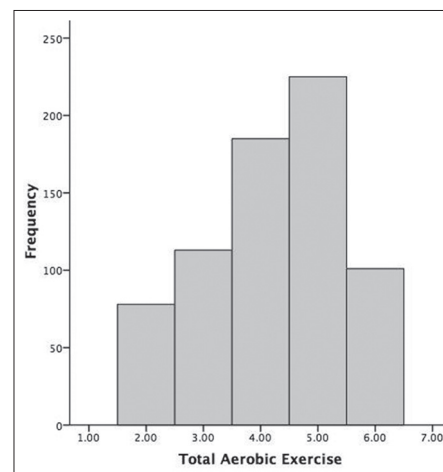


Figure 2: Histogram of total aerobic activity. Scores range from 0 for no activity to 6 the highest possible response for aerobic activity

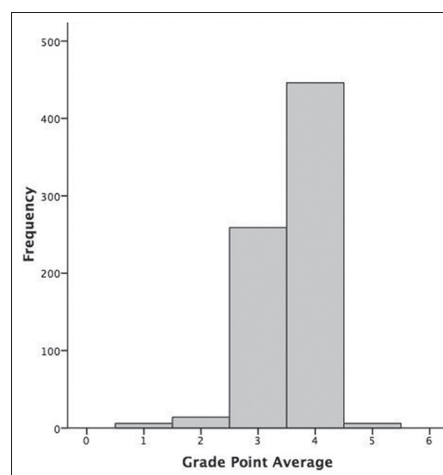


Figure 3: Histogram of reported grade point average. Possible responses were 00.99 (1), 11.99 (2), 22.99 (3), 33.99 (4), 4.0 and above (5)

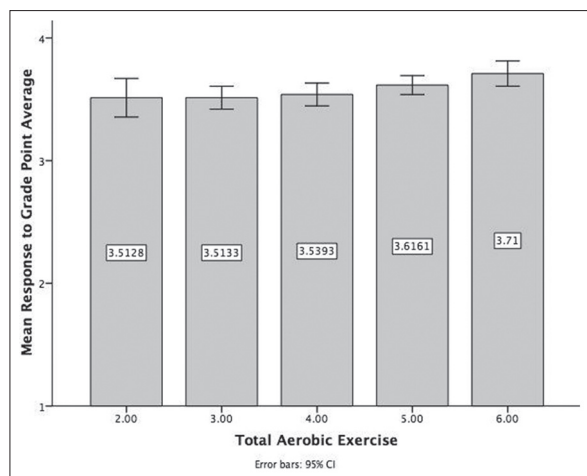


Figure 4: Mean response to grade point average by aerobic activity. Range for aerobic activity 06, 6 representing the greatest response. Possible responses for grade point average were 00.99 (1), 11.99 (2), 22.99 (3), 33.99 (4), 4.0 and above (5). Error bars represent 95% confidence intervals

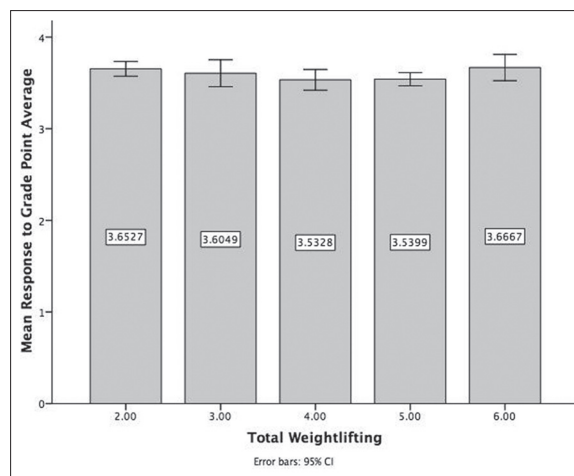


Figure 5: Mean response to grade point average by weightlifting activity. Range for weightlifting activity 06, 6 representing the greatest response. Possible responses for grade point average were 00.99 (1), 11.99 (2), 22.99 (3), 33.99 (4), 4.0 and above (5). Error bars represent 95% confidence intervals

levels of physical activity garnered through team sport or increased activity outside of the physical education courses was related to academic performance. Tomporowski *et al.*,^[9] in a recent review of the findings in children, suggested that exercise might enhance children’s mental functioning. The present investigation builds upon the evidence of a relationship between physical activity and exercise to academic performance by demonstrating similar findings among Midwestern and Southern University students.

It should be noted that a previous study conducted in Kuwait^[14] reported no relationship between results of a health promoting lifestyle, which included assessment of reported physical activity and academic performance. However, the Kuwait study examined a smaller sample of students ($n = 224$) and the students were all nursing majors. The limited sample size and relative similarity of population may, in part, be responsible for this finding. The present investigation included a larger sample ($n = 740$) from two different geographic regions within the United States.

Although the results of the present investigation leave much of the variance in GPA unexplained, it has been demonstrated that there are many other factors that are related to academic performance such as the socioeconomic status.^[16] Physical activity in college students has also been shown to relate to a number of other factors such as happiness,^[17] consumption of fruit^[3,18] and to be largely dependent on self-efficacy for exercise of the student.^[19] As physical activity is only one variable of many that can explain some variance in academic performance, it is understandable why the demonstrated effect sizes are smaller in magnitude and why a small sample size, such as in Al-Kandari and Vidal,^[14] would likely result in a non-finding. Although the relationships are small, college students’ academic achievement is critical, therefore, any demonstrated relationship to academic performance is an important finding.

The secondary trend that weightlifting was negatively related to academic performance was not a surprising one. The recent physiological findings regarding BDNF^[11] suggest a plausible mechanism by which aerobic exercise may enhance the cognitive function. Some studies have suggested a relationship between resistance exercise and cognitive function.^[20] However, a majority of these studies have been conducted on older adults.^[21-23] Given the lack of evidence in younger populations, a plausible explanation for the negative impact of resistance exercise and academic performance may be that the two are unrelated and time spent engaged in resistance training reduces the available time for academic pursuits. This may be similar to the reported negative relationship with video gaming, as time spent engaged in video gaming would reduce time spent in studying. This relationship warrants further investigation in order to understand and more fully characterize the relationship.

CONCLUSION

On the basis of the results of the present investigation, it can be suggested that colleges and universities focus on the facilitation of aerobic exercise for students, through either outdoor or indoor opportunities. Given the number of universities across the country that currently have or are in the process of building large student centers for exercise, it can be suggested that these centers be constructed and staffed in such a manner that aerobic exercise is encouraged. In addition, colleges and universities can further encourage aerobic activity through offering physical education or activity courses to students who are focused on learning and practicing exercise types that promote aerobic fitness. These courses can be offered for a variety of different exercise modes, such as fitness walking, jogging, and swimming.

The provision of aerobic exercise can also be met through an active recreation and intramural sports program. If activities

or sports are offered that promote aerobic activity, this will increase the availability of fitness-related activities to the students. A university or college with well-designed facilities, physical education and activity courses, and recreation departments, which all promote aerobic exercise, will offer students an ideal setting to engage in aerobic exercise.

Although resistance training showed a negative trend toward academic performance in the present investigation, centers should still incorporate strength training equipment, as resistance training is an important component for the development of overall health-related lifetime fitness.

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Source of Support: Nil, Conflict of Interest: None declared