University Students Meeting the Recommended Standards of Physical Activity and Body Mass Index

by Xiaofen Deng, and Darla Castelli, The University of Texas at Austin; Jose Castro-Pinero, The University of Cadiz; Hongwei Guan, Ithaca College

Abstract

This study investigated student physical activity (PA) and body mass index (BMI) in relation to the *Healthy Campus 2010* objectives set by the American College Health Association in 2002. Students (N = 1125) at a U.S. southern state university participated in the study. The percentages of students who were physically active and whose BMI were categorized as overweight and obese were compared with the goals in the *Healthy Campus 2010*. Only 33.9% and 28.9% of students participated in at least three days of moderate physical activity or MPA, and vigorous physical activity or VPA, respectively, while 25.6% of students were classified as overweight and obese. Students did not meet the goals set out in the *Healthy Campus 2010*.

Key words: changes of physical activity behaviors

It has been well documented that physical activity (PA) and body mass index (BMI) are primary factors affecting individuals' overall health (US Dept. of Health and Human Services [USDHHS], 2001). Public health groups have attempted to increase PA and decrease BMI in the general population in the US for more than three decades (USDHHS, 1996, 2001). Although obesity related interventions are needed at all levels in society, regardless of age, gender, and ethnicity (USDHHS, 2001), university students are a unique subgroup because most of them are young adults at a transitional time, learning to live independently while simultaneously working toward attainment of advanced professional degrees (Bray & Born, 2004; Keating, Guan, Castro, & Bridges, 2005).

Research has pointed out that it is important to help university students adopt a healthy lifestyle consisting of adequate PA and a healthy diet due to the following three reasons. First, university students may play a critical role in developing social and cultural norms because they may well become decision-makers and opinion leaders; Second, many university students decrease their PA levels (Gyurcsik, Bray, & Brittain, 2004; Keating et al., 2005; McArthur & Raedeke, 2009) while their BMIs rise (Adams & Rini, 2007; Crombie, Ilich, Dutton, Panton, & Abood, 2009). To date, only 30% to 50% of university students meet the recommended amount of PA for health benefits (Keating et al., 2005; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). The third reason that this group should be targeted for intervention is that young adulthood PA and diet habits have valuable carry-over effects. Maintaining PA and BMI during university may generate positive effects on student lifestyles in the years after graduation. It has been suggested that PA habits during the senior year of college were one of the strongest predictors of PA levels in the years following graduation (Sparling & Snow, 2002). Therefore, the period in higher education has been identified as a critical juncture to halt declining PA involvement and increasing BMI (American College Health Association [ACHA], 2010; Keating et al., 2005; McArthur & Raedeke, 2009). Further study is warranted on how PA guidelines/ standards/recommendations for this age group have impacted the regularity of student PA engagement. When health concerns are public, policies/recommendations have been utilized as a means for changing individuals' behavior, by bringing them closer to the desired norms (i.e., being physically active for 150-mins each week). For these reasons, it is important to monitor the overall PA and BMI and their changes within this population and implement effective interventions to ensure that university students have developed a healthy lifestyle by the time they graduate.

After more than three decades of attempting to reverse obesity in the U.S. population (USDHHS, 2001), unfortunately, it seems that higher education has not been able to effectively help students increase PA and reduce BMI. For instance, research monitoring student PA changes in the first two years in university indicated that 30% of students reported no exercise during freshman year and no significant changes were found at the second year (Racette et al., 2005). Moreover, significantly fewer students took part in aerobic PA and more students just performed stretching exercises from the freshman to sophomore year. In response to these obesity-related public health issues, ACHA (2002) developed *Healthy Campus 2010: Making it happen*. Within the document, ACHA specifically attempted to accomplish the following PA and BMI goals in higher education by 2010: (a) increase the percentage of college students who engage in PA for at least 3 days per week at moderate PA (MPA; 3.5 to 7 calories per minute, depending on the fitness level) for at least 30 minutes, or vigorous PA (VPA; 7 to 10 calories per minute depending on the fitness level) for 20 minutes or more from 40.3% to 55%; and (b) reduce the proportion of students who are overweight and obese from 29.5% to 16%.

To date, a few studies have examined college student PA and BMI (Behrens, Dinger, Heesch, & Sisson, 2005; Dart & Davis, 2008; Kahan, 2009; Keating et al., 2005; McArthur & Raedeke, 2009; Mestek, Plaisance, & Grandjean, 2008). As expected, it was found that one to two thirds of students did not engage in PA for at least three days weekly (Huang, Harris, Lee, Nazir, Born, & Kaur, 2003; Staten, Miller, Noland, & Rayens, 2005; Sullivan, Keating, Chen, Guan, Delzeit-McIntyre, & Bridges, 2008). In terms of student BMI, studies reported that 28.8% of females and 39.4% of males were overweight or obese; which was different from other targeted populations (ACHA, 2009; Huang et al., 2003). As of 2010, however, no research has thoroughly examined whether the PA and BMI objectives listed in the *Healthy Campus 2010* (ACHA, 2002) are achieved on campuses and therefore the effectiveness of these public guidelines is unknown. Moreover, few studies have thoroughly investigated PA and BMI changes during the entire time when students are in higher education. Although it is critical to issue a document such as *Healthy Campus 2010: Making it happen*, because it provides the guidelines for promoting healthy behaviors among students in higher education, the actual stimulation of progress toward the identified goals is of greater

concern. This information is needed to guide future PA and BMI interventions in higher education. Moreover, knowledge of student PA and BMI changes over the duration of the college experience is valuable to better understand these two key issues related to university student health. Therefore, this study aimed to analyze the data collected by ACHA to examine if a large southern state university had met the objectives listed in the *Healthy Campus 2010* (ACHA, 2002). The secondary purpose was to examine changes in PA and BMI by years in university, gender, and ethnicity in order to gain more knowledge concerning effects of higher education on helping students combat obesity and physical inactivity.

Methods

Data collected by ACHA at the university in 2008 were used in the study. Since the study used existing data with no individual identification, no human subject committee approval was needed.

Participants

There were 1125 students with useable data. Females consisted of 61.5% of the sample. Concerning ethnicity, participants were Whites (57.0%), Asians (20.5%), and Latinos (17.2%), which is similar to that of the university population. In addition, the majority of the under-graduates were full-time students. Refer to Table 1 for detailed demographic information.

Table 1. ***General Information of Participants***

Variables	Mean (*SD*)	N (%)
Age	22.21(4.82)	
Gender		
Male		433 (38.5)
Female		692 (61.5)
Ethnicity		
Whites		641 (57.0)
Latinos		194 (17.2)
Asians		231 (20.5)
Others		59 (5.2)
General health		
Excellent		184 (16.4)
Very good		461 (41.0)
Good		378 (33.6)
Fair/poor		102 (9.1)
Full time student status		
Yes		1070 (95.1%)
No		55 (4.9%)
Years in school		
1st year undergrad		297 (26.4%)
2nd year undergrad.		129 (11.5%)
3rd year undergrad.		188 (16.7%)
4th year undergrad.		181 (16.1%)
5th year & beyond		330 (29.3%)

Campus Characteristics

The large southern state university in the US enrolls 50,000 students annually. University buses service the edge of campus and the greater community regularly, and courses are scheduled back-to-back with minimal break time in between. There are two large student recreational centers and a number of outdoor exercise facilities (i.e., jogging trails, basketball courts, tennis courts, etc). The university does not have any health education and/or physical education requirements included in the general education core requirements. PA courses, however, are available for electives. The weather is pleasant for outdoor activities most of the year except when it is excessively hot in the summer.

Measures

Based on the purposes of the study, the following variables were chosen from the existing data set: (a) demographics (i.e., gender and ethnicity). Although age was included in the survey, the variable was not analyzed in the study due to its small variation (*SD* = 4.8); (b) PA variables. While there were three self-reported PA variables (i.e., number of days participated in MPA, VPA, and muscular strength [SPA] for at least 30 min. each week), only the variables of MPA and VPA were selected from the existing dataset to be dependent variables. The reason for not including SPA was that there was not an objective for SPA in the *Healthy Campus 2010*; and (c) BMI: Self-reported weight and height data were converted to BMI, using the formula weight in kg/height2 in meters (World Health Organization [WHO], 2006). Students were classified as underweight (i.e., BMI < 20), desired weight (i.e., 20 < BMI < 25), overweight (i.e., 25 < BMI < 30), and obese (i.e., BMI > 30) (WHO, 2006) based on their BMI value.

Data Collection

The data were collected by ACHA-National College Health Assessment (ACHA-NCHA) using an online self-reported survey in 2008. Similar data have been collected nationwide since 2004 with the purpose of helping universities understand student health related behaviors (ACHA, 2009, 2010). All students at the university were asked by email to complete the survey voluntarily. Data were cross sectional and did not provide information about individual changes over time. Refer to ACHA (2010) for more detailed information concerning the survey.

Data Screening and Reduction

The data were first screened for missing values and outliers. Those individuals (i.e., 2.17% in total) with excessive missing values (i.e., more than 50%) were deleted from the data set as MANOVAs do not allow any missing values (Meyers, Glenn, & Guarino, 2006). Furthermore, necessary data reduction was also performed before meaningful data analyses were conducted. Specifically, there were only 24 African-American students in total so there was not enough statistical power to analyze this variable; as a result, they were combined with those in the ethnicity category of 'Others'.

Data Analysis

Based on the purposes of the study, the two types of dependent variables were PA measures in MPA and VPA in the number of days, and BMI. The independent variables were gender, ethnicity, and years in university. The descriptive analyses (i.e., frequency, means, and standard deviations) of the aforementioned variables were conducted first. MANOVAs were performed to test MPA and VPA differences in gender, ethnicity, and years in university,

respectively. All significant MANOVAs were followed by post hoc tests (i.e., univariate F test) and the appropriate effect sizes were calculated. Owing to the categorical nature of BMI, the chi-square test was employed to test percentage differences in each BMI category by the above categorical variables. According to Sheskin (2007), there is not a consensus with respect to what method should be used as a post hoc test for significant chi-square tests. Standardized residuals, however, are recommended for comparison.

As a rule of thumb, $Z_{.05}$ = 1.96 and $Z_{.01}$=2.58 indicate $p < .05$ and $p < .01$, respectively. Effect sizes were also computed for significant results (Meyers et al., 2006). The cut-off values of effect size for the F statistics were measured by partial eta squared (i.e., η^2), which is the proportion of total variance that is attributed to an effect (Meyers et al., 2006). Values for small, medium, and large eta squared were .01, .09, and .25, respectively (Cohen, 1988). Significance was set a priori at a *p*-value of less than .05. All these data analyses were completed using SPSS 18.0 (SPSS, 2009).

Results

Overall PA and BMI, and the Status of Meeting the Healthy Campus 2010 Objectives

The percentage of students who reported being involved in at least three days of MPA, and VPA, were 33.9% and 28.9%, respectively, falling far behind the targeted objective included in the *Healthy Campus 2010* (i.e., 55%). In addition, 39.5% of students reported no PA at all. Regarding BMI, 25.6% of students were classified as overweight and obese, comparing to the goal of 16%. More detailed information regarding student overall PA and BMI is presented in Table 2.

Table 2. ***Overall Weekly Physical Activity Levels and BMI***

Variables	Mean (*SD*)	N (%)
PA		
Days of MPA	1.55 (1.65)	
Participating in at least 3 days of MPA		293 (26.0%)
Days of VPA	1.09 (1.48)	
Participating in at least 3 days of VPA		197 (17.5%)
Without any PA		444 (39.5%)
BMI		
Underweight		60 (5.3%)
Desired weight		777 (69.1%)
Overweight		217 (19.3%)
Obese		71 (6.3%)

NOTE: The total did not add up to 100% due to missing data.

PA Differences in BMI

Table 3 presents PA variables by BMI. MANOVA revealed that there was no significant PA differences in BMI [Wilks' Lambda = .98, $F_{(6, 2240)}$ = 1.98, $p > .05$]. Although not statistically significant, the desired weight group had higher mean days of participating in at least 3 days of both MPA and VPA than the other groups. Similar to findings reported in previous studies on the topic, the obese group had the least amounts of MPA and VPA (see Table 3).

Table 3. ***Physical Activity Levels by BMI***

Variables			MPA	VPA
		N	Mean (*SD*)	Mean (*SD*)
BMI				
	Underweight	60	1.20 (1.54)	.80 (1.33)
	Desired weight	777	1.62 (1.68)	1.15 (1.51)
	Overweight	217	1.50 (1.58)	1.11 (1.46)
	Class I obesity	71	1.24 (1.56)	.63 (1.17)

PA and BMI Differences by University Years

Differences of MPA and VPA by years in university were tested by MANOVA and the results were not significant [Wilks' Lambda = .99, $F_{(8, 2236)}$ = .69, $p > .05$] (see Table 4). Moreover, the chi-square test indicated that BMI difference by years in university was significant [$\chi^2 12 = 20.25$, $p < .05$] with the 5th year and graduate group of students having the highest percentage of individuals classified as overweight.

PA and BMI Differences in Gender and Ethnicity

MANOVA revealed that MPA, and VPA were significantly different by gender [Wilks' Lambda = .99, $F_{(2, 1116)}$ = 4.18, $p < .05$] with a small effect size (i.e., $\eta^2 = .007$), and ethnicity [Wilks' Lambda = .96, $F_{(6, 2232)}$ = 7.32, $p < .01$] also with a small effect size (i.e., $\eta^2 = .02$). The interaction between gender and ethnicity was not significant [Wilks' Lambda = .99, $F_{(6, 2232)}$ = 1.31, $p > .05$]. Post hoc tests indicated that males performed more MPA and VPA than their female counterparts. In terms of ethnicity, Whites performed significantly more MPA and VPA than all other ethnicities, while

Table 4. ***PA Means (SD) and BMI Percentage Differences in Year in University***

Variables	MPA (SD)	VPA (SD)	Underweight	Desired Weight	Overweight	Obese
Years in university						
1st year	1.15(1.67)	1.13(1.50)	7.41%	69.36%	14.81%	8.42%
2nd year	1.62(1.60)	1.24(1.53)	5.43%	74.42%	16.28%	3.88%
3rd year	1.55(1.62)	1.06(1.47)	5.32%	71.81%	19.15%	3.72%
4th year	1.56(1.56)	1.10(1.44)	3.31%	71.27%	19.34%	6.10%
5th & Beyond.	1.55(1.71)	1.00(1.48)	6.22%	63.94%	24.55%*	6.97%

Note: * $p < .05$

Table 5. ***Physical Activity Means (SD) and BMI Percentage Differences in Gender and Ethnicity***

Variables	MPA	VPA	Underweight	Desired Weight	Overweight	Obese
Gender						
Female	1.18(.09)*	.84(.08)**	7.37%**	71.97%	15.17%**	5.49%
Male	1.47(.11)*	1.20(.10)**	2.08%**	64.43%	25.87%**	7.62%
Ethnicity						
Whites	1.85(.07)**	1.26(.06)**	4.37%	72.23%	18.41%	4.99%
Latinos	1.25(.11)**	1.04(.11)	3.61%	65.98%	18.56%	11.87%**
Asians	1.24(.11)**	.92(.10)	9.52%**	66.23%	20.35%	3.90%
Others	.85(.22)**	.85(.20)**	5.08%	55.93%	27.12%	11.86%

Note: ** $p < .01$; * $p < .05$.

no differences of MPA and VPA were found among the other ethnic groups.

The chi-square tests found that BMI differences in both gender ($\chi^2_3 = 33.87$, $p < .001$) and ethnicity ($\chi^2_9 = 31.31$, $p < .001$) were significant. The standardized residuals suggested that more females were in the category of underweight than their male counterparts while the opposite was found in the overweight group. Concerning BMI differences in ethnicity, Asians had significantly higher BMI percentages of underweight ($Z = 2.8$, $p < .01$), while Latinos had a higher percentage of overweight than all other groups ($Z = 3.1$, $p < .01$). Refer to Table 5 for more detailed information relating to PA and BMI by gender and ethnicity.

Discussion

It is important to understand student PA and BMI during the formative stage when university students are entering young adulthood and establishing a foundation for adult life patterns. As one of the last formal opportunities to implement PA and BMI interventions to a large segment of young adults, higher education may have the potential to promote PA and reduce BMI during these years. This study is the first attempt to examine university student PA and BMI in accordance with objectives listed in *Healthy Campus 2010* (ACHA, 2002). The results of the study are particularly valuable as there is a need to determine the impact of PA guidelines on behaviors as a means of informing the development of future interventions targeting university students (Keating et al., 2005). Overall, there are three important findings that warrant the attention of professionals in the fields of fitness, health, and physical education. First, students at the university are not moving toward attaining the PA and BMI goals established in *Healthy Campus 2010* (ACHA, 2002). Second, in a comparison of class cohorts, it appears that the university experience did not improve student PA and BMI significantly. In some instances PA and BMI actually deteriorated, despite being in an educational environment that could serve as an ideal opportunity for a supported behavioral change to be enacted. Finally, there were notable gender and ethnicity differences in both PA and BMI, suggesting that future PA interventions need to be gender and ethnic sensitive.

Meeting PA and BMI Goals in the Healthy Campus 2010

It is encouraging that ACHA (2002) has set specific PA and BMI objectives in *Healthy Campus 2010*. Naturally, ACHA might have expected that most campuses, if not all, would have implemented necessary interventions to meet those objectives. Nevertheless, to date, little to no progress data regarding the outcome variables have been available to indicate whether the objectives are reachable on any campus. Empirical studies have indicated that merely developing objectives or issuing calls actually produce little effects on changing PA and BMI (Keating, Lambdin, Harrison Jr., Dauenhauer, & Rotich, 2010). Therefore, data are needed to monitor university student PA and BMI to encourage universities to reach such objectives. As 2010 has passed, ACHA must reassess the status of the objectives listed in *Healthy Campus 2010: Making it happen* (ACHA, 2002). Moreover, future research should investigate incentives needed for universities to respond to ACHA's call for promoting PA and reducing BMI.

Meeting PA objectives in Healthy Campus 2010. It is important to point out the following two issues before addressing meeting PA objectives. First, the recommended adequate amounts of PA have been increased from at least three days of 30-mins MPA or 20-mins VPA (ACHA, 2002) to at least 150-mins (i.e., five days of 30 min.) of MVPA weekly (USDHHS, 2009). As the primary purpose of the study was to examine whether the university's students had met the PA goals included in the *Healthy Campus 2010*, the newly recommended adequate amount of PA was not used. Second, although MVPA has become a commonly used variable to analyze student overall PA in studies on the topic (Boyle & LaRose, 2008; Cardinal, Jong-Young, & Young-Ho, 2010; Cardinal & Spaziani, 2007), as noted earlier, the PA goals included in the *Healthy Campus 2010* used days of MPA and VPA separately, and no MVPA objective was employed (ACHA, 2002). As a result, MVPA was not examined in the current study. It might be necessary to also set an objective of MVPA for *Healthy Campus* in the future so that the overall effects of PA can be explored.

The data from the study are in line with that found in previous studies (Jackson & Howton, 2008; McArthur & Raedeke, 2009; Suminski, Petosa, Utter, & Zhang, 2002) that the university has failed to reach the recommended PA goal. It is alarming that about 39.5% of students reported no MVPA, which is higher than the percentage Haberman and Luffey (1998) found (i.e., 12.3%), putting students at a higher risk for poor health. In view of overwhelming evidence that physical inactivity is one of the leading factors causing life-threatening diseases (USDHHS, 2001), the health of this completely sedentary group of students is of concern and calls

for immediate PA intervention. ACHA also needs to implement effective strategies to increase the accountability of universities in terms of promoting PA on campus.

Meeting targeted BMI objectives in Healthy Campus 2010. The targeted objective in the *Healthy Campus 2010* was to reduce the overweight and obese rate to 16% (ACHA, 2002). The large state university again has not been able to meet the BMI objective in the *Healthy Campus 2010*. In fact, the result supported the contention that the prevalence of overweight and obesity among college students remained the same over the last 10 years, even though ACHA has constantly addressed obesity on campuses (ACHA, 2002). While each campus might have launched PA and obesity related interventions in response to ACHA's call for healthy campuses, the lack of positive change in college students' overweight and obesity rates at the university cast doubts on the effectiveness of those interventions, if any.

This lack of impact toward reducing obesity and increasing PA leads us toward the investigation of PA and obesity related interventions implemented in higher education. A handful of studies on the topic have been reported (Keating et al., 2005; McFarlin & Jackson, 2008), including the use of the internet (Raedeke, Focht, & King, 2010). In general, positive outcomes concerning PA and BMI improvement have been demonstrated (Weinstock, 2010). A thorough examination of the literature on the topic suggested that higher education has not utilized general curriculum requirements about health and fitness education as one of the interventions (Sailors et al., 2010; Sparling, 2003), indicating the lack of follow-up from each individual university for ACHA's (2002) call for healthy campuses. It is puzzling why higher education has not acted more urgently to strengthen PA and fitness education, such as including certain PA and health education units in every academic program to combat obesity among students. The data from the study seem to support the notion that simply setting and creating an awareness of the standard is not enough (Keating et al., 2010). Clearly, college students need an incentive toward achieving these goals. Because knowledge and skills are related to the occurrence of behaviors (Behrens et al., 2005), and the strength of education is to empower students to make beneficial decisions about their behavior, the result of the study echoes the recommendation of Sparling (2003) and Staten, Miller, Noland, and Rayens (2005) that it is necessary to revisit general education requirements for physical education classes if ACHA really meant to demonstrate a commitment to promoting healthy lifestyles among students in higher education. Given that PA declines with age, it is very likely that those sedentary as well as overweight and obese students will remain the same if higher education is not having an impact on improving their lifestyles (Bray & Born, 2004).

PA and BMI Differences in Years in University

Tracking PA and BMI over time during the tenure in higher education is essential (Levy & Cardinal, 2006), but it is not easy because of the mobility of the population. Despite the tendency of PA to decline with age while BMI shifts in the opposite direction, the need for students to maintain sound health cannot be overstated given its role in completing studies, as healthy students can learn better academically (El Ansari & Stock, 2010). The data uncovered in this paper relating to the insignificant changes of student PA and the increase of BMI by years in university provide us with valuable information about the ineffectiveness of higher education alternating the two health-related variables. This line of research warrants more attention from health and physical education professionals (Adams & Rini, 2007).

PA differences by years in university. The data from the study indicated that student MPA levels did not change over the years in higher education, nor did their VPA. This result is different from some of the previous studies on the topic indicating that student PA levels decreased as years in college increase (Keating et al., 2006; Racette et al., 2005). In addition, studies have noted that it was the VPA that significantly decreased among students in the first year of university attendance (Bray & Born, 2004; Dart & Davis, 2008). Unfortunately, the study did not have participant specific VPA data in their last year of high school to support the previous finding. While not significant, a pattern was found in which students in their second year of college had the highest amount of MPA and VPA (see Table 4). This pattern is in line with that found by Keating and colleagues (2006) using a sample of Chinese college students. Moreover, the data from the study supported the finding reported by Dart and Davis (2008) that student PA patterns in the first year of college sets the basis for their young adulthood PA levels, as participants in the study remained at the same low level of PA throughout their university years. Overall, the low and unchanged student PA levels over their years in the university are disheartening given that ACHA has constantly promoted PA on campus for about a decade. Future research needs to explore factors which diminished the impact of ACHA's efforts.

BMI differences by years in university. Student BMI did not change significantly over the first four years, even though the percentages of overweight and obese individuals increased each year. Of more importance, there was a significant increase of BMI at the 5th year and beyond in university. Research has reported that college students usually gained 15 pounds in the first year of college (WHO, 2006) and it is widely believed that the first year of college is critical for weight gain (Anderson, Shapiro, & Lundgren, 2003; Dart & Davis, 2008). The study, however, did not contain any information regarding student weight changes from their last year of high school to the freshmen year. Therefore, it was impossible to examine student weight gain in the first year of college. The data from the study did show a rising trend in BMI by years in university ending with the 5th year and beyond students, who had the highest percentage of overweight and obese (see Table 4). The BMI data also suggested that the university has not helped students solve their weight problems as indicated by the rise in BMI by years in university. This is a reason for concern given that university students have not been successfully educated to take care of their own health or even if they may have been, have not been following through in any meaningful way.

PA and BMI Differences in Gender and Ethnicity

PA differences in gender and ethnicity. The results concerning PA differences in gender are conflicting; however, many studies have found that female students participated in less PA than their male counterparts (Keating et al., 2005; McArthur & Raedeke, 2009). The data from the study supported the previous finding that females performed significantly less MPA, and VPA than males

(McArthur & Raedeke, 2009), even though the effect size was small. Considering similar results found by previous studies on the topic, more effective PA interventions among college female students would seem to be a priority. In terms of ethnicity, the results of this study are similar to earlier reports in the literature, namely, that Whites had the highest amount of PA, while Asians had the least (McArthur & Raedeke, 2009; Suminski et al., 2002). It seems that the evidence for ongoing discrepancy in PA by ethnicity still exists, if not growing, in comparison with findings reported by previous studies (Dart & Davis, 2008; McArthur & Raedeke, 2009), but meanwhile, there have not been effective research efforts to either understand it or to combat it, as few studies targeting the promotion of PA among underserved ethnic groups have been found. Therefore, more research is needed to examine how to bridge the gap among ethnic groups.

BMI differences in gender and ethnicity. Research has suggested that females are more concerned about their weight in general (Soh, Touyz, & Surgenor, 2006), and indeed the study found that more male than female students were overweight and obese. As a result, more weight management interventions should be implemented among male students. In addition, while obesity is certainly an issue of health, it is also a cultural or ethnic matter related to beauty (Kahan, 2007; Sjostedt, Schumaker, & Nathawat, 1998; Soh et al., 2006). It has been reported that the relationship between BMI and gender might be a reflection of culture as it was found that Latinos view being overweight as beautiful (Kahan, 2007), while White and Asian cultures view being overweight as the opposite (Sibai, Hwalla, Adra, & Rahal, 2003; Sjostedt et al., 1998). Given that the majority of participants in this study were Whites, caution should be exercised when interpreting the result broadly. Regarding BMI by ethnicity, the result from the study is in line with previous findings that Whites are the group with the lowest percentage in the categories of overweight and obese (McArthur & Raedeke, 2009; Suminski et al., 2002). It is disheartening that the health disparity among various ethnic groups has not been significantly narrowed after years of attempting to combat disparities in health problems (ACHA, 2002).

It is interesting to point out that Asians were the least physically active group; however, they have the highest percentage of BMI in the category of 'underweight' among all ethnic groups in the study. This result might be puzzling considering past findings which indicated that college students who reported inactivity tended to be more overweight or obese than their peers (Sjostedt et al., 1998). Again, the finding might be explained by cultural differences. Sjostedt and colleagues (1998) noted that the cultural value of preferring being thin might result in problematic eating disorders. Therefore, cultural factors need to be taken into consideration when combating weight problems (i.e. being either underweight or overweight) among students with different cultural backgrounds.

Limitations

As with most survey studies, the study has the following limitations: (a) the data were collected using a self-reported survey and it is well-known that people tend to over-report their PA (McArthur & Raedeke, 2009); (b) there is the potential that those who choose to respond to surveys may be engaging in the desired behavior with greater prevalence than those who choose not to respond (Isaac & Michael, 1995). Therefore, the data presented here are likely to indicate the highest level of PA possible and students may actually be exercising less than reported; and (c) because of the cross-sectional nature of the study, we were unable to longitudinally track changes of student PA and BMI. Caution, therefore, needs to be exercised when generalizing the results of the study to the wider population.

Summary

The results of the study support the finding of Gruber (2008) that there is far less consensus on how to prevent, intercede, reduce, or eliminate obesity and physical inactivity in higher education. It is important to understand the role that the university environment may play in halting the obesity epidemic, and to develop institutional strategies that might educate college students to pursue a healthier lifestyle throughout higher education and beyond. While the *Healthy Campus 2010* is a milestone document in attempting to reverse obesity and physical inactivity among university students, there is a need to ensure that the goals are actually met or at least attempted. This study marks the first attempt to evaluate a campus in terms of meeting the identified PA and BMI goals in the *Healthy Campus 2010*. More intervention is needed if ACHA is serious about educating college students to adopt a healthy lifestyle for the rest of their lives. The present findings suggest that students in the university under study did not meet the PA and BMI objectives set in *Health Campus 2010*. Student PA and BMI also did not significantly change during their tenure in higher education. New and more innovative efforts to increase PA participation and reduce BMI among college students are needed.

References

Adams, T., & Rini, A. (2007). Predicting 1-year change in body mass index among college students. *Journal of American College Health, 55*(6), 361-365.

American College Health Association. (2002). *Healthy Campus 2010: Making it happen*. Baltimore, MD: Author.

American College Health Association. (2009). American College Health Association National College Health Assessment, Spring, 2008. Reference Group Data Report (abridged). *Journal of American College Health, 57*, 477-488.

American College Health Association. (2010). *American college health association national college health assessment*. Retrieved from www.acha-ncha.org.

Anderson, D.A., Shapiro, J.R., & Lundgren, J.D. (2003). The freshman year of college as a critical period for weight gain: An initial evaluation. *Eating Behaviors, 4*, 363-367.

Behrens, T.K., Dinger, M.K., Heesch, K.C., & Sisson, S.B. (2005). College students' understanding of moderate physical activity: A qualitative study. *American Journal of Health Studies, 20*(3/4), 129-134.

Boyle, J.R., & LaRose, N.R. (2008). Personal beliefs, the environment and college students' exercise and eating behaviors. *American Journal of Health Studies, 23*(4), 195-200.

Bray, S.R., & Born, H.A. (2004). Transition to university and vigorous physical activity: Implications for health and psychological well-being. *Journal of American College Health, 52*(4), 181-188.

Cardinal, B.J., Jong-Young, L., & Young-Ho, L. (2010). Predictors of transitional shifts in college students' physical activity behavior. *International Journal of Applied Sports Sciences, 22*(1), 24 °V 32.

Cardinal, B.J., & Spaziani, M.D. (2007). Effects of classroom and virtual "lifetime fitness for health" instruction on college students' exercise behavior. *Physical Educator, 64*(4), 205-213.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*

(2nd ed.). Hillsdale, NJ: Erlbaum.
Crombie, A.P., Ilich, J.Z., Dutton, G.R., Panton, L.B., & Abood, D.A. (2009). The freshman weight gain phenomenon revisited. *Nutrition Reviews, 67*(2), 83-94.
Dart, L., & Davis, M. (2008). Vigorous physical activity patterns among college students. *TAFCS Research Journal, 1*(1), 22-24.
El Ansari, W., & Stock, C. (2010). Is the health and wellbeing of university students associated with their academic performance? Cross sectional findings from the United Kingdom. *International Journal of Environmental Research and Public Health, 7*(2), 509-527.
Gruber, K.J. (2008). Social support for exercise and dietary habits among college students. *Adolescence, 43*(171), 557-575.
Gyurcsik, N.G., Bray, S.R., & Brittain, D.R. (2004). Coping with barriers to vigorous physical activity during transition to university. *Family Community Health, 27*, 130-142.
Huang, T.T.K., Harris, K.J., Lee, R.E., Nazir, N., Born, W., & Kaur, H. (2003). Assessing overweight, obesity, diet, and physical activity in college students. *Journal of American College Health, 52*(2), 83-86.
Isaac, S., & Michael, W.B. (1995). *Handbook in research and evaluation* (3rd ed.). San Diego,
Jackson, E.M., & Howton, A. (2008). Increasing walking in college students using a pedometer intervention: Differences according to body mass index. *Journal of American College Students, 57*, 159-164.
Kahan, D. (2007). Overweight and its relationship to Middle Eastern American college students' sociodemographic and physical activity. *Research Quarterly for Exercise for Sport, 78*, 248-256.
Kahan, D. (2009). Quantity, type, and correlates of physical activity among American Middle Eastern university students. *Research Quarterly for Exercise and Sport, 80*, 412-23.
Keating, X.D., Guan, J., Castro, J., & Bridges, D.M. (2005). A meta-analysis of college student physical activity levels. *Journal of American College Health, 64*, 116-215.
Keating, X.D., Haung, Y., Guan, J., Deng, M., Zhu, L., & Dwan, C. (2006). Southern Chinese collegiate student leisure-time physical activity patterns. *ICHPER•SD Journal of Research, 1*(2), 18-26.
Keating, X.D., Lambdin, D., Harrison, L. Jr., Dauenhauer, B., & Rotich, W. (2010). Changes of physical education programs from 2001 to 2006. *Research Quarterly for Exercise and Sport, 81*, 180-188.
Levy, S.S., & Cardinal, B.J. (2006).Factors associated with transitional shifts in college students' physical activity behavior. *Research Quarterly for Exercise and Sport, 77*(4), 476-485.
McArthur, L.H., & Raedeke, T.D. (2009). Race and sex differences in college student physical activity correlates. *American Journal of Health Behavior, 33*(1), 80-90.
Mestek, M.L., Plaisance, E., & Grandjean, P. (2008). The relationship between pedometer-determined and self-reported physical activity and body composition variables in college-aged men and women. *Journal of American College Health, 57*(1), 39-44.
Meyers, L.S., Glenn, G., & Guarino, A.J. (2006). *Applied multivariate research: Design and interpretation*. Thousand Oaks, CA: Sage Publications, Inc.
Racette, S.B., Deusinger, S.S., Strube, M.J., Highstein, G.R., & Deusinger, R.H. (2005). Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. *Journal of American College Health, 53*, 245-251.
Raedeke, T.D., Focht, B.C., & King, J.S. (2010). The impact of a student-led pedometer intervention incorporating cognitive-behavioral strategies on step count and self-efficacy. *Research Quarterly for Exercise and Sport, 81*, 87-96.
Sailors, M.H., Jackson, A.S., McFarlin, B.K., Turpin, I., Ellis, K.J., Foreyt, J.P. et al. (2010). Exposing college students to exercise: The Training Interventions and Genetics of Exercise Response (TIGER) study. *Journal of American College Health, 59*(1), 13-20.
Sheskin, D. (2007). *Handbook of parametric and nonparametric statistical procedures* (4th ed.). Boca Raton: Chapman & Hall/CRC.
Sibai, A.M., Hwalla, N., Adra, N., & Rahal, B. (2003). Prevalence and covariate of obesity in Lebanon: Findings from the first epidemiological study. *Obesity Research, 11*, 1353-1361.
Silverman, S., Keating, X.D., & Phillips, S. (2008). A lasting impression: A pedagogical perspective on youth fitness testing. *Measurement in Physical Education and Exercise Science, 12*(3), 146-166.
Sjostedt, J.P., Schumaker, J.F., & Nathawat, S.S. (1998). Eating disorders among Indian and Australian university students. *Journal of Social Psychology, 138*(3), 351-357.
Soh, N.L., Touyz, S.W., & Surgenor, L.J. (2006). Eating and body image disturbances across cultures: A review. *European Eating Disorder Review, 14*, 54-65.
Sparling, P.B. (2003). College physical education: An unrecognized agent of change in combating inactivity-related diseases. *Perspectives in Biology and Medicine, 46*(4), 579-587.
Sparling, P.B., & Snow, T.K. (2002). Physical activity patterns in recent college alumni. *Research Quarterly for Exercise and Sport, 73*, 200-205.
SPSS. (2009). *SPSS for Windows*, Rel. 18.00. Chicago: SPSS, Inc.
Staten, R.R., Miller, K., Noland, M.P., & Rayens, M.K. (2005). College students' physical activity: Application and ecological. *American Journal of Health Studies, 20*(1/2), 58-65.
Sullivan, S.L., Keating, X.D., Chen, L., Guan, J., Delzeit-McIntyre, L., & Bridges, D. (2008). Physical education and general health courses and minority community college student risk levels for poor health and leisure-time exercise patterns. *College Student Journal, 42*(1), 132-151.
Suminski, R.R., Petosa, R., Utter, A.C., & Zhang, J.J. (2002). Physical activity among ethnically diverse college students. *Journal of American College Health, 51*(2), 75-80.
Suminski, R.R., Petosa, R., Utter, A.C., & Zhang, J.J. (2002). Physical activity among ethnically diverse college students. *Journal of American College Health, 51*(2), 75-80.
US Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General, Atlanta*, GA: Author.
US Department of Health and Human Services. (2001). *The Surgeon General's call to action to prevent and decrease overweight and obesity*. Rockville, MD: Author.
Weinstock, J. (2010). A review of exercise as intervention for sedentary hazardous drinking college students: Rationale and issues. *Journal of American College Health, 58*(6), 539-544.
World Health Organization. (2006). *Addressing the socioeconomic determinants of healthy eating habits and physical activity levels among adolescents*. Venice, Italy: Author. ■