

Research Article

BMI and Physical Activity in College Students Assessed Using the International Physical Activity Questionnaire (IPAQ)

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Abstract

A volunteer sample of 100 first-year college students were recruited to examine their body fat percentage levels and to investigate the association between their body fat and their levels of physical activity. Body fat percentage scores were regressed stepwise on college students' vigorous physical activity, moderate physical activity, walking, and gender. The results of the regression indicated that the model explained 35.0% of the variance, and two factors such as vigorous PA and gender were significant predictors of first-year college students' body fat percentage, $F(1,78)=56.00$, $p<0.001$. The rest of the variables entered were the moderate PA and walking, and these were not significant factors.

Keywords: BMI, Physical Activity, IPAQ

Introduction

More than 70% of U.S. adults and 30% of college students were classified as either overweight or obese, and it is reported that 18.4% of adolescents were classified as obese [1-6]. Although the etiology of obesity is multifactorial, insurmountable evidence supports the premise that obesity is highly correlated with physical inactivity [7,8]. Of the various factors leading to obesity in college students, physical activity levels have been consistently reported to be a significant factor in maintaining normal body weight and lowering the risks of developing chronic conditions, including type II diabetes, heart diseases, hyperlipidemia, and hypertension [9,10]. To prevent young adults from developing chronic diseases, the American Heart Association (AHA) recommends individuals get at least 150 minutes per week of moderate-intensity aerobic physical activity [11,12]. Despite this recommendation, only half of the adults aged 18 and over met the 2008 federal physical activity guidelines from 2016 to 2018 [13]. In a meta-analysis conducted by Keating and his colleagues (2005) on the college students' physical activity levels, they found that half of the college student population did not meet the AHA's recommended physical activity [14]. It is noteworthy that according to an observational study by Clemente et al. (2015), male students walked more steps and spent more time in a moderate and vigorous activity than female students [15-17].

Examining the levels of physical activity requires a thorough process of measuring all types of physical activities and calculating the energy expenditure associated with each type and level of physical

activity. International Physical Activity Questionnaire (IPAQ) is designed to measure individuals' level of physical activity and its metabolic equivalents (METs), allowing researchers to examine the relationship between these factors [18]. Liu and his colleagues' study conducted in 2015 demonstrated that physical activity levels were a mediating factor in the subjects' body mass index measured by the IPAQ forms. They also found that lower BMI scores were positively correlated with moderate and vigorous physical activity, while higher BMI scores were positively correlated with insufficient physical activity [19]. A cross-sectional study of a volunteer sample of 738 college students conducted by Huang and his colleagues that examined the collective effects of dietary intake and physical activity on college students' BMI found a correlation between physical activity and BMI in late adolescents and early adults, supporting the hypothesis that physical activity was a significant predictor of BMI [20].

The BMI has been widely used in research and clinical practice in the last 30 years when reporting adults' obesity in predicting their health risks for chronic diseases. However, Coral and his colleagues pointed out the limitations of the BMI measure in a cross-sectional study of 13,601 subjects from the National Health and Nutrition Examination Survey (NHANES): the diagnostic accuracy of BMI in measuring adiposity is limited because the BMI does not account for variations in body composition (i.e., the relative proportion of total fat versus skeletal muscle mass) [21-23]. Therefore, it is a concern when research is aimed at predicting college students' future health risks based on the BMI measure because some college students who are either athletes or are extremely muscular were misclassified as obese.

To address this concern, the National Heart, Lung, and Blood Institute recommends using not only BMI but other anthropometric measures that are a good indication of individuals' health risks, including body fat percentage, waist circumference, and waist-hip ratio. In the past decades, numerous studies have steadily reported the danger of college students' weight gain based on their BMI. However, only a small portion of the research measures college students' obesity using BMI and anthropometric measures to predict their future health risks [24-27]. Despite a multitude of studies reporting first-year college students' weight gain, the majority of the findings of such studies did not measure the first-year college students' baseline anthropometric information [28]. Thus, this study aimed to measure in-coming first-year college students' baseline obesity before their exposure to the college lifestyle and investigate the association between young adults' body fat percentage levels and their physical activity levels.

Methodology

Subjects

A volunteer sample of 100 college freshmen was recruited from a total of 900 incoming freshmen in Fall 2015. Recruitment strategy was conducted through trained undergraduate student volunteers. These volunteers were visiting the foyers of college resident dormitories to distribute flyers to freshman students on the opportunity to participate in this study.

Procedures

Before participating in this research researchers handed out informed consent forms to explain the purpose of the research and any potential harms and benefits and discomforts that were associated with participating this research in order to prevent any potential harms or coercion of student participants. After that, participants were asked to complete a survey that asks questions about their eating behaviors and physical activity. The questions are general and do not imply that they are in any inappropriate behavior. The survey takes about 25 minutes to complete. After survey completion, participants' height, weight, waist circumference, tricep skinfold and calf skinfold were measured.

Measures

International Physical Activity (IPAQ) short form was used to measure college students' physical activity levels, and anthropometric (physical measures) were taken for height, weight, waist circumference, tricep skinfold and calf skinfold using standardized protocols from National Institute of Health (NIH).

Results

Demographic Information

Of the 100 first-year college students in the study, 57% (n=57) were males and 43% (n=43) were females. The mean age was 18.53 (SD=1.20) for males and 18.26 (SD=0.51) for females, where the youngest students were 18 year old and the eldest were 25 years old. Table 1 depicts the participants' anthropometric data, including weight in kilogram, and height, waist, and hip in centimeters.

Body Fat Percent Distributions by Gender

As illustrated in Table 2, the study subjects (n=100) were classified as essential fat (n=7), athletes (n=35), fitness (n=18), acceptable (n=26), and obese (n=14) based on the American Council on Exercise (ACE)'s fat norms for men and women. The majority of male students (n=39, 90.7%) and female student (n=47, 82.5%) were found to be within the normal body fat percentages. Concerning the first-year students' obesity, obesity rates of females were almost twice higher than that of males: 9.3% of male and 17.5% of female students, respectively.

The statistical analysis verified a significant difference in the mean body fat percentage of male students compared to that of female students (Welch's two-sample t-test: $t=-7.309$ with $df=98$, $p<0.05$). The mean body fat percentages of the male students were 14.04% (SD=6.45), and those of the female students were reported to be 25.21% (SD=9.11).

Levels of Physical Activity by Gender

As seen in Table 3, descriptive data analyses on college students' levels of physical activity showed that male students engaged in more days of physical activities per week compared to female students.

Table 1: Participants' Anthropometric Information.

	Weight (kg) Mean (SD)	Height (cm) Mean (SD)	Waist Mean (SD)	Hip Mean (SD)	Body Fat Mean (SD)
Male	72.80 (13.24)	174.02(9.96)	80.32(9.72)	98.77(7.75)	14.04(6.45)
Female	64.06(16.77)	161.62(7.42)	79.06(13.55)	99.78(10.78)	25.21(9.11)

Table 2: ACE's Body Fat Percentage Distributions by Gender.

American Council on Exercise (ACE)'s Fat Norms for Men and Women					
	Essential Fat	Athletes	Fitness	Acceptable	Obese
Men	(2-5%)	(6-13%)	(14-17%)	(18-24%)	(>25%)
Women	(10-13%)	(14-20%)	(21-24%)	(25-31%)	(>32%)
This Study					
Men	7.0% (n=3)	58.1% (n=25)	11.6% (n=5)	14.0% (n=6)	9.3% (n=4)
Women	7.0% (n=4)	17.5% (n=10)	22.8% (n=13)	35.1% (n=20)	17.5% (n=10)

Table 3: Mean Days of Physical Activities (PA) per Week.

		Male		Female			
Days of PA							
Per Week	n	Mean	SD	n	Mean	SD	P-value
Vigorous PA	43	3.19	2.42	57	1.33	1.84	0.00*
	43	4.16	2.51	57	3.00	2.19	0.09
	43	5.33	2.33	57	4.91	2.22	0.77

(Note: Physical Activity (PA), * Statistically significant at 0.05).

Table 4: Regression results of body fat percentages dependent on vigorous PA, moderate PA, walking, and gender.

Step	Variables	R ²	AdR ²	R ² Change	p-value
1	Vigorous PA	0.06	0.51	0.60	0.01*
2	Moderate PA	0.07	0.05	0.01	0.19
3	Walking	0.10	0.07	0.02	0.08
4	Walking	0.35	0.33	0.25	0.00

*Statistically significant at 0.05.

Of the three levels of physical activity, the most common type of physical activity was walking in both male and female students: 5.33 days for males and 4.91 days per week for females. It is noteworthy that there was a statistically significant difference in first-year students' mean days of vigorous physical activity per week. Specifically, the mean days of vigorous physical activity per week for male students was almost three times higher than those of the first-year female students: $t=7.619$ ($df=98$), $p<0.05$.

Predictors of Obesity by Levels of Physical Activity and Gender

The main purpose of this study was to assess the association of body fat percentage scores with college students' vigorous physical activity, moderate physical activity, walking, and gender in the context of stepwise regression. Before each of the possible predictor entered into the regression equation one at a time, the main assumptions of the multiple regression models were examined. The normal Q-Q plots were used to check the normality of the data, which appears to be normally distributed. The multicollinearity test showed all the factor's VIF scores were less than four, which implies that the predictors were not highly correlated with each other. The results of the regression in Table 4 indicated that the full model explained 35% of the variance in body fat percentages, and vigorous PA and gender were two significant predictors of first-year college students' body fat percentage: $F(1.78)=56.00$, $p<0.001$. The rest of the variables entered were the moderate PA and walking, and these were insignificant factors.

Discussion/Limitations

The incoming first-year college students' body fat levels were measured by the average thickness of subcutaneous fat in their two body regions, including calf and triceps. Surprisingly, the average body fat percentages of the participants were found to be lower than the national obesity rate of young adults. However, it is noteworthy that the first-year female students' body fat percentage was reported to be almost twice higher than that of male students.

The mean days of different types of physical activity per week were compared between the male and female students to see if there were any gender differences of body fat levels, and the vigorous physical

activity was shown to be an important factor among the three types of physical activities: vigorous physical activity, moderate physical activity, and walking. When three types of the physical activity levels were entered into the stepwise regression along with the gender factor, vigorous level of physical activity and gender were the significant factors in explaining the levels of the first-year college students' body fat percentages. In addition, when the vigorous physical activity level was entered in the model, it accounted for six percent of the variance, and this indicates that first-year students who were engaging in the vigorous level of physical activity were less likely to be obese.

There were some limitations of this study that might influence the result. One of the weaknesses of this study might be the fact that the first-year college students' levels of physical activity were measured by an instrument that heavily relies on participants' recall and self-report in nature. Although the IPAQ-SF's validity and reliability were well-documented in several studies, one of the common drawbacks of the IPAQ-SF was that it tends to overestimate physical activity levels.

While first-year college students' body fat percentage levels were found to be lower than the national average young adults', the timing of the body fat measurement could be an important factor leading to a lower body fat percentage of the subjects. The first-year students' body fat was measured during the freshman orientation period rather than few months into their academic semester where they could be exposed to different college lifestyle related factors, including types of food choices, levels of stress, academic demands. Lastly, anthropometric data such as body weight, height, and waist and hip circumference were collected from the first-year college students; therefore, there is a potential sample bias that participants who were reluctant to disclose their anthropometric data could have been excluded from this study.

Conclusion

Obesity rates of first-year female students were to be almost twice higher than those of male students. Such gender gap could be explained by the type of physical activity performed, where male students were more often doing the vigorous level of physical activity than the female students.

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