Freshman 15: Fact or Fiction?

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Abstract

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Objective: The objective of this study was to investigate changes in body weight, BMI, body composition, and fat distribution among freshman women during their 1st year of college.

Research Methods and Procedures: Freshman women during the 2004 to 2005 academic year were recruited to participate. The initial baseline visit occurred within the first 6 weeks of the fall 2004 semester, with the follow-up visit occurring during the last 6 weeks of the spring 2005 semester. At each visit, height, weight, BMI, waist and hip circumferences, and body composition (by DXA) were obtained.

Results: One hundred thirty-seven participants completed both the fall and spring visits. Significant ($p < 0.0001$) increases between the fall and spring visits were observed for body weight (58.6 vs. 59.6 kg), BMI (21.9 vs. 22.3), percentage body fat (28.9 vs. 29.7), total fat mass (16.9 vs. 17.7 kg), fat-free mass (38.1 vs. 38.4 kg), waist circumference (69.4 vs. 70.3 cm), and hip circumference (97.4 vs. 98.6 cm), with no significant difference observed in the waist-to-hip ratio (0.71 vs. 0.71; $p = 0.78$).

Discussion: Although statistically significant, changes in body weight, body composition, and fat mass were modest for women during their freshman year of college. These results do not support the purported "freshman 15" weight gain publicized in the popular media.

Key words: college students, weight gain, women, body composition

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Introduction

The incidence of obesity among adults in the United States increased by ~50% per decade throughout the 1980s and 1990s, with the trend expected to continue (1). Particularly worrisome are data from the Behavioral Risk Factor Surveillance System that show the greatest increase in overweight and obesity from 1991 to 1998 in the United States occurring in the 18- to 29-year-old age group (from 7.1% to 12.1%), with those having "some college education" exhibiting even greater increases (from 10.6% to 17.8%) (2). This trend portends badly for the future health of America and, in fact, has led some to predict a potential decline in life expectancy in the United States in the 21st century (3–5).

Entering college at 18 to 19 years of age has been recognized as a "critical" period that dictates whether individuals will live healthy lifestyles in their subsequent adult years (6). Results from the National College Health Risk Behavior Survey indicate that college students are developing poor nutritional and physical activity habits, which may lead to future health burdens later in life (7). In 2003, Huang et al. (7–9) reported that 22% of college students in his sample were overweight or obese, whereas others suggest rates as high as ~30%. Therefore, if this critical period of transition from high school to college is ignored, it is possible that these health habits will be carried through the college years into adulthood, with inevitable weight gain and a whole constellation of obesity-related disorders, such as stroke, heart disease, diabetes, and cancer, occurring later in life.

A common belief among the lay public is that body weight increases after entry into college, and the phrase "freshman 15" has been coined to describe the 15 pounds that students presumably gain over their freshmen year. However, little scientific evidence exists to substantiate or rebut this commonly held belief (10,11). The few studies that have examined weight gain among freshmen college students are equivocal. Some showed a significant weight

gain (10,12,13), whereas others reported no significant weight increase (14,15). The inconsistent findings may be due, in part, to studies using different follow-up periods (i.e., only a portion of the freshman year, a portion of the freshman and sophomore years, or, in a few studies, the entire freshman year), the use of small sample sizes ($n = 40$ to 60), and the inclusion of both men and women. Additionally, no study that we are aware of has studied changes in body composition using DXA. Other studies have relied on body weight as the sole outcome measure, which does not allow for detecting changes in fat and fat-free mass (10,11,15,16). Given the limitations of past studies investigating weight gain in college students, this study was implemented to track body weight and body composition changes in a cohort of women over the fall and spring semesters of their freshman year of college.

Research Methods and Procedures

Participants

After approval by the Institutional Review Board, freshmen women attending a large Midwest university (University of Oklahoma, Norman, OK, with an enrollment of ~25,000 students) were recruited by mass e-mail, flyers posted around the campus, and announcements in college courses popular with freshmen women. Inclusion criteria were the following: female, enrolled as a full-time freshman at the university during the fall 2004 semester and planning to be enrolled during the spring 2005 semester, and 18 to 21 years old at the time of the initial fall visit. Exclusion criteria were the following: pregnant or planning to become pregnant during the study period, participation in any of the university's intercollegiate athletic teams, participation in any organized sports team, having a metabolic disease that affects body weight and body distribution (e.g., Cushing's Syndrome), and taking medication or drugs known to impact body weight and distribution (e.g., steroids, growth hormone, ephedrine, and nicotine).

Study Design

The study used a one-group, longitudinal research design. The outcome measures were the participants' body weight, BMI, body composition, and fat distribution. Data were collected during the first 6 weeks of the fall 2004 semester and the last 6 weeks of the spring 2005 semester.

Measures

For descriptive purposes, demographic characteristics and physical activity were assessed using self-administered written surveys and the International Physical Activity Questionnaire short-form (17). For this study, minutes per week spent performing moderate and vigorous physical activities were assessed.

Weight and height were measured with a balance beam scale and stadiometer (Detecto Manual Physician, Webb City, MO), respectively, and used to compute BMI (kilograms per meter squared). For measurement of both height and weight, participants were instructed to remove their shoes and all heavy clothing (e.g., sweaters, jackets, belts). A plastic flexible Gulick tape measure was used to assess waist and hip circumferences. The waist measurement was taken at one-half the distance between the bottom of the xiphoid process and the umbilicus, and the hip measurement was taken at the largest anterior protrusion. The ratio between waist and hip was computed as a measure of fat distribution.

DXA model Lunar DPX-IQ (Lunar Corporation, Madison, WI) was used to assess body composition, specifically percentage body fat, total fat mass, and total fat-free mass. To prevent discrepant readings among multiple assessors, scans were performed and analyzed by one technician using software version 4.7b. Calibration of the DXA occurred at the beginning of each day of testing. For the scan, subjects were placed on the DXA scanning table; straps were placed around the ankles to keep them in the correct position. Anterior posterior thickness was measured at the midsection to determine the appropriate scan speed. The visit lasted ~30 minutes. The day-to-day coefficient of variation for the estimation of percentage fat mass in our laboratory is 1%.

Protocol

Potential participants were screened by telephone and e-mail. Each eligible participant was then scheduled to visit the Body Composition Laboratory within the first 6 weeks of the fall 2004 semester. Participants were instructed to arrive for their visit having fasted for at least 6 hours, with no exercise occurring within 24 hours. At the visit, participants were re-screened to confirm eligibility. Each eligible participant completed informed consent and Health Insurance Portability & Accountability Act of 1996 forms, completed the demographic and physical activity questionnaires, had height and weight assessed, and had hip and waist circumferences measured. Subjects were then scanned with the DXA.

Participants were contacted by telephone and e-mail during the first half of the spring semester to schedule the follow-up visit within the last 6 weeks of the semester. The follow-up visit included the same procedures used during the baseline visit for measurement of all anthropometric and body composition variables. The average number of weeks between visits was ~29 weeks, with a range of 24 to 33 weeks. Study results for each visit were given to the subject; however, no interpretation of the results was given.

Data Analysis

Paired sample Student's t tests were used to evaluate changes in the outcome variables [i.e., body weight, BMI,

Table 1. Descriptive characteristics of study completers ($N = 137$)

Variables	2004 Fall visit
Age (years) [mean ± standard deviation (range)]	18.2 ± 0.7 (18 to 19)
Sorority member [*n* (%)]	70 (51%)
Housing [*n* (%)]	
Dormitory	132 (96%)
Off-campus	5 (4%)
Race [*n* (%)]	
Native American	7 (5%)
Asian	1 (1%)
African American	7 (5%)
Hispanic	1 (1%)
White	116 (85%)
Other	5 (4%)

body composition (percentage body fat, total fat, and fat-free mass), and fat distribution (waist and hip circumferences and waist-to-hip ratio)], between the fall and spring visits. The physical activity data were not normally distributed; therefore, changes from the fall and spring visits were examined using Wilcoxon signed ranks tests. To determine whether dropouts differed significantly from study completers, independent samples Student's *t* tests were calculated for several baseline demographic and body composition variables, and Mann-Whitney *U* tests were calculated for physical activity. Body composition variables and physical activity were compared between those who gained weight vs. those who lost weight using independent samples *t* test and Mann-Whitney *U* tests, respectively. Statistical significance was set at $p < 0.05$.

Results

One hundred seventy-one women attended the baseline visit, and 137 of these returned for the follow-up visit (80% completion rate). Of the 34 participants who dropped out, one became pregnant, three transferred, and 30 did not respond to repeated attempts to schedule the follow-up visit. The participants who dropped out of the study did not differ from those who completed the study with regard to age (18.2 ± 0.4 vs. 18.1 ± 0.4 years), body weight (59.1 ± 8.3 vs. 58.5 ± 8.2 kg), BMI (21.3 ± 2.5 vs. 21.9 ± 2.8 kg/m^2), percentage fat (27.9 ± 6.5 vs. 28.9 ± 5.5), moderate physical activity (median, 90 vs. 60 min/wk), or vigorous physical activity (median, 30 vs. 80 min/wk).

The demographic characteristics of the study completers are presented in Table 1. At baseline, they were age 18 to 19 years, lived mainly in student dormitories on campus, and were predominately white. Approximately one-half were members of sororities. On average, they engaged in 1 hour of moderate physical activities and almost 1.5 hours of vigorous physical activities per week.

Participants' body weight increased significantly ($p \leq 0.0001$) between the fall and spring semesters (Table 1 and Figure 1), with an average weight gain of 1.1 ± 2.6 kg (2.42 pounds). Significant increases were also observed in BMI, percentage body fat, total fat and fat-free mass, and waist and hip circumferences ($p \leq 0.001$; Table 2). However, no significant changes were observed in the waist-to-hip ratio or in minutes per week of moderate and vigorous physical activities.

Changes in body composition variables and physical activity were examined between those who gained weight vs. those who lost weight. No statistically significant changes were observed for body composition or physical activity ($p > 0.05$). However, subjects who gained weight over the year tended to weigh more, have greater amounts of fat mass, and be less active than those who lost weight during the year.

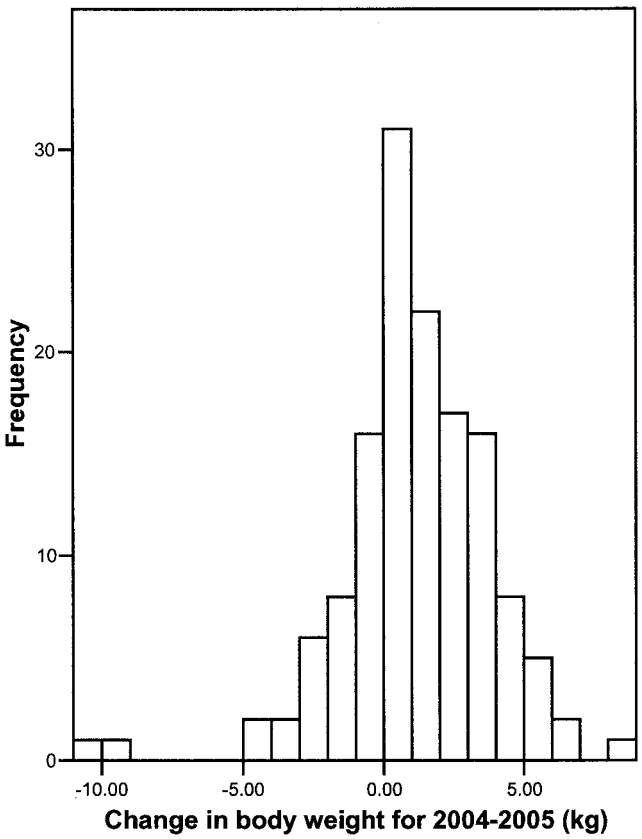

Figure 1: Distribution of changes in body weight for the 2004 to 2005 academic school year among study completers.

Table 2. Height, body weight, body composition and fat distribution, and physical activity variables for completers

Variables	2004 Fall	2005 Spring	Δ (Spring to Fall)	*p*
Height (cm)	163.4 ± 6.2 (148 to 186)	163.5 ± 6.1 (148 to 187)	0.1	NS
Weight (kg)	58.6 ± 8.2 (41 to 86)	59.7 ± 8.1 (41 to 91)	1.1	<0.000
BMI (kg/m^2)*	21.9 ± 2.5 (16 to 29)	22.3 ± 2.5 (17 to 31)	0.4	<0.000
Percentage fat	28.9 ± 5.5 (16 to 47)	29.7 ± 5.6 (16 to 47)	0.8	<0.000
Total fat mass (kg)	16.9 ± 5.0 (7 to 33)	17.7 ± 5.2 (7 to 33)	0.8	<0.000
Total fat-free mass (kg)	38.1 ± 4.1 (29 to 54)	38.4 ± 4.1 (30 to 53)	0.3	<0.000
Waist circumference (cm)	69.4 ± 5.8 (58 to 96)	70.3 ± 5.6 (59 to 96)	0.9	<0.000
Hip circumference (cm)	97.4 ± 6.0 (83 to 114)	98.6 ± 6.1 (85 to 117)	1.2	<0.000
Waist-to-hip ratio	0.71 ± 0.04 (0.62 to 0.90)	0.71 ± 0.04 (0.64 to 0.90)	0	NS
Moderate physical activity† (min/wk)	60.0	60.0	0	NS
Vigorous physical activity† (min/wk)	80.0	60.0	−20	NS

Data reported as mean ± standard deviation and (range). *p* Value refers to paired Student's *t* tests or Wilcoxon signed ranks tests. NS, not significant.

* Twelve subjects were classified as overweight (25 to 29.9 kg/m^2) at the fall visit, and 19 were classified as overweight at the spring visit. No subjects were obese (≥30 kg/m^2) for either the fall or spring visit.

† Median score for this sample.

Discussion

This study examined changes in body weight and composition in women entering their freshman year of college, with the intent of confirming or disproving the freshman 15 myth. The results do not support the belief that freshman women gain 15 pounds during their 1st year of college; in fact, our data indicate the weight gain to be substantially less (i.e., 2.4 pounds). These findings were surprising given the common belief that the early college years have a deleterious effect on body weight. It may be that this erroneous belief is perpetuating negative attitudes about body weight in freshman college students and, consequently, having negative long-term health ramifications (16). Graham and Jones (16) have reported that the fixation on the freshman 15 myth is responsible for freshmen students having negative feelings about their body weight and image while being more likely to categorize themselves as being overweight.

The 2.42-pound weight gain observed in this study represented a gain of 38 g/wk, which was substantially less than the weight gain among freshmen men and women reported by Levitsky et al. (158 g/wk), Hovell et al. (77 g/wk), Matvienko et al. (104 g/wk), and Racette et al. (~79 g/wk) (10–13). A potential explanation for this wide discrepancy in quantity of weight gain could lie in the length of the study period. Studies that used a shorter timeframe, such as those of Matvienko et al. (i.e., only the spring semester) and Levitsky et al. (i.e., 12 weeks), reported greater amounts of weight gain per week than those using longer timeframes, such as Racette et al. (fall of freshman year to spring of sophomore year) and Hovell et al. (entire freshman year) (10–13). Hovell et al. (10) surmised that as college students progress through college, the rate of increase in body weight plateaus, resulting in weekly averages in weight gain being lower in studies with longer follow-up periods. This theory could explain the lower rate of weight gain observed in our study compared with previous studies.

As observed for body weight, changes in body composition were also modest between the fall and spring visits. Interestingly, the 2.4 pounds of total weight gained, however, were not all fat; only 73% of the increase in body weight was due to an increase in total fat mass. At this time, we are unsure whether this finding is common, given that previous studies have not used DXA to track body composition changes in college-aged students.

Although an increase of 38 g/wk or 1.2 pounds per semester in body weight is modest, it represents an intake of just 292 additional kcal each week or an additional 42 kcal/d, which is less than one slice of bread or one banana. Herein lies the problem: a seemingly small increase in caloric intake can have a profound and substantive impact on body weight. At the rate of 1.2 pounds per semester, not including summer breaks, college women could gain 9.6 pounds by the time they graduate. Consequently, small

changes in energy intake or expenditure over the college years could lead to college women being overweight on graduation. To combat increases in weight among this population, innovative interventions that promote healthy diet and physical activity to freshmen women, while providing a supportive environment for performing these behaviors, are needed.

Strengths of this study are noteworthy. Its major strength was the use of DXA, which enabled the researchers to differentiate changes in body weight as either fat or fat-free mass. To our knowledge, this study is the first to employ DXA to study changes in body weight among college students. Previous studies of weight gain in college students used BMI as a surrogate measure of body fat, which does not give a "qualitative" measure of body weight. Other strengths were the sample size ($n = 137$), which was larger than samples recruited in most previous studies of weight gain in college students, and the timeframe between visits, ~29 weeks, which was longer than follow-ups used in most previous studies of this topic. One final strength of this study was the high retention rate: ~80% of participants completed both the fall and spring visits. Having a high retention rate minimized the potential effect of those participants who gained the greatest amount of weight not returning for their follow-up visit, which would obfuscate the true weight increase in this cohort of participants.

This study was not without limitations, which included potential self-selection bias and the lack of nutritional intake data. Self-selection bias was likely to have occurred because women who were interested in learning about changes in their body weight may have been more likely to volunteer to participate than women who were not. In a population hypersensitive about body weight, women who were overweight or obese may have been too embarrassed to have the researchers measure their body size. As a result, our sample consisted of very lean women. The mean BMI for the initial fall visit was 21.9 kg/m^2, well within the normal BMI range, with no participant being obese (i.e., ≥30 kg/m^2). Consequently, no inferences can be made regarding the change in body weight and composition in obese women during their freshmen year. Furthermore, our cohort was physically active, with ~50% of participants meeting the current vigorous physical activity recommendation at both data collection points (18). Therefore, it is likely that our study participants were not representative of freshman women at the University of Oklahoma during the fall 2004 semester. The second limitation is that no nutritional data were collected that would allow for the calculation of caloric and macro-/micronutrient intake. The collection of nutritional data could have provided a clearer picture of the energy balance equation while also supplying information on the impact of diet composition on body weight. Without this information, it is unclear whether energy intake or energy expenditure contributed more to increases seen in body weight over the freshmen year. Also unclear is the role, if any, that macro-/micronutrient intake played on the regulation of body weight. Lastly, the fact that one-half of the study sample consisted of sorority girls cannot be understated. In all likelihood, this study represented a highly self-selected sample, which might have influenced the findings.

For future study of weight gain in college students, we make the following recommendations. First, qualitative assessment of the barriers to participation and possible incentives for participation in such studies among overweight and obese college students should be conducted. Data collected from such assessments can improve recruitment and retention plans for these students. Second, men should be recruited for inclusion into these studies because body weight and body image are not exclusively a female problem (19,20). Third, nutritional tools that assess total caloric intake and macro-/micronutrient composition of the diet should be added. Information gathered from such assessments would allow for relationships between components of the diet and weight gain to be evaluated.

In conclusion, the results of this study indicate that body weight and body fat increased significantly among women during their freshman year of college. However, this increase is modest, suggesting that the purported freshman 15 weight gain publicized in the popular media is an unlikely occurrence, at least in populations similar to the one studied here. In fact, only one participant gained the freshman 15.

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