Change in Diet, Physical Activity, and Body Weight in Female College Freshman

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Objective: **To examine diet, physical activity, and body-weight changes associated with relocation from home to university.** ***Methods***: **Diet, fitness/physical activity, body-weight parameters and self-efficacy were assessed among 54 freshman women upon college entry and 5 months later.** ***Results***: **Although caloric intake significantly decreased, a significant increase occurred in body-weight parameters that may be attributed to significant decreases in total physical activity.** ***Conclusions***: **Interventions are needed aimed at increasing physical activity; improving diet quality related to consumption of vegetables, fruits, breads and pasta, and meats; and decreasing alcohol consumption.**

Key words: **obesity, energy equation, weight management, self-efficacy, college student health**

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The overweight/obesity pandemic has created a renewed interest in the etiology of weight gain.[1,2] Interest in the etiology of weight gain also has been renewed because the pandemic has spread to younger populations as indicated by the National Collegiate Health Risk Survey, which revealed that 1 in 5 college students is overweight (BMI [kg/m^2] $\geq$ to 27.8 for men and 27.3 for women).[3] It also has been noted that between 1976-1980 (NHANES II) and 1988-1991 (NHANES III), the prevalence of overweight adults in the US population increased by 31% and is continuing to rise.[4] The total average caloric intake, however, from 1977-1978 to 1987-1988 in women decreased by 3% (equivalent to 53 Kcal/day) and fat intake (adjusted for total calories) decreased by 11%.[5] These divergent trends in overweight/obesity and fat and energy intake patterns have been described as the "American Paradox."[5] Dietary intake has received more attention than physical activity for weight reduction because studies have shown reduced energy intake to be more effective for weight loss than increased physical activity.[6] Investigators have concluded that even without adequate information concerning physical activity, "the only available explanation for the paradoxical increase in body weight with a decrease in fat and energy intake is that physical activity declined."[5]

Whether the recent rise in body weight in the US population is a result of changes in dietary habits, physical activity levels, or both, increased body weight represents a change in lifestyle. It may, therefore, be instructive to study other situations that involve lifestyle alterations that do not

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specifically target dietary patterns or physical activity levels, but yet have been associated with changes in body weight. One such alteration in lifestyle associated with increased body weight is the transition of leaving home to attend college. This relocation involves changes in the social and physical environments as well as cognitive and behavioral adaptations, which may impact dietary patterns and physical activity levels. Thus, energy balance parameters (energy intake, energy expenditure, and change in energy stores) can be examined in a specific population that traditionally has been reported to gain weight unrelated to growth or maturation.

Research has shown that college freshmen who begin their tenure at a university gain weight.[7-9] The research conducted with entering college freshman females revealed weight gain of different magnitudes from less than 1 lb after 6 months of college to 8.52 lb during the entire freshman year. Hovell et al[7] found that college freshmen women were 2.6 to 5.2 times as likely as women who did not leave home to gain 15% or more above their ideal weight.

It also is important to identify key variables that explain dietary and physical activity behaviors in order to plan and implement interventions to prevent weight gain that may be permanent among college students. Self-efficacy related to diet and physical activity is one construct to consider because adopting new institutional arrangements and practices may negatively affect self-efficacy.[10] Studies have revealed that self-efficacy is the most consistent and major influence on exercise behavior in both healthy and unhealthy adults.[11-13]

The overarching purpose of this study was to address the dietary, fitness/physical activity, and body weight parameter changes among freshman female college students during the first semester of university after relocation from home. An extension of previous research was to examine dietary intake and energy expenditure self-efficacy questions specific to relocation to a college campus.

METHODS

Participants

The M age of participants (n=82) in the initial sample (54 subjects completed the study) was 17.79 years old; 8.54% were 17 whereas 91.46% were 18 years old. All were unmarried and resided in residence halls at a large Midwestern university. Subjects were predominantly white (92.68%). The remaining 3.66% were Asian, Pacific Islander, or Native American, and an additional 3.66% were African American. The M height was 64.31 in. (SD=2.49), and weight was 136.85 lb (SD=23.38). The M BMI of the participants was 23.31 (SD=3.72). Participants displayed a normal (~50th percentile age 20-29 classification)[14] percentage body fat with a M of 21.87 (SD=5.59). Total caloric intake for the participants (n=81) was 2292.3 Kcal/day (SD=1010.39 Kcal/day).

Procedures

Recruitment, data collection, and follow-up. The campus committee on the use of human research subjects approved all study procedures. Incoming freshman women were recruited in a variety of ways to include posting of advertisements, hand-distributed letters during an orientation, and by word-of-mouth. Interested participants were instructed to sign up for a 1-hour time slot at the main office of 5 of the residence halls that housed 96.5% of freshman female students. Participants were contacted by telephone, e-mail, and campus mail to remind them about the appointment. Women who signed up for an allotted time slot, but failed to show up, were contacted again by phone.

The investigators traveled to the 5 participating residence halls to collect data. Because the committee on the use of human research subjects required full disclosure of all procedures prior to initiation of the study, the subjects were informed of the posttest meeting that would be held ~20 weeks later. Subjects were uninformed of their pretest and posttest results until 3 weeks after the posttest meeting. After the 5-month study period, the subjects were contacted again by phone, e-mail, and campus mail to inform them of the 5 available times and dates for the second data collection. Individuals who did not return for the second data collection were contacted again by phone to remind them of the final data collection.

Study variables. The study variables were body parameters, dietary intake, fitness/physical activity, and diet and physical activity self-efficacy. Body parameter variables included height (in.), body weight (lb), body composition (% bodyfat), fat mass (lb), fat-free mass (lb), and BMI. Dietary variables were based on food serving and daily nutrient consumption. Fitness/physical activity variables include estimated VO_2 max (ml/kg/min), recovery heart rate, and occupational, sports, nonsports leisure and total physical activity.

Body parameter measurements. Height was measured to the nearest quarter inch and weight to the nearest quarter pound with a Detecto balance beam, physician's scale (Webb City, Mo, model # 3P704). Body mass index (BMI) was calculated according to the following formula: (w)kg/(h)m^2.[15] A Harpenden skinfold caliper (Model 3496, Quinton Instruments, Burgess Hill, West Sussex, England) was used to estimate body composition. An average of 3 skinfold measurements were taken at the triceps, iliac, and thigh. Skinfold measurements were repeated until the 3 measurements taken were within 2 mm of one another. Body density and body composition (fat mass and fat-free mass) were computed taking into account gender, age, and ethnicity.[16,17] The same exercise physiologist completed all body composition measurements.

Dietary intake. The Block[18] Food Frequency Questionnaire (FFQ), which has been developed from and used in the National Health and Nutrition Examination Surveys,[19] was selected for assessment of dietary intake. Correlations between scores from diet diaries and scores from the FFQ exceeded .70.[18] The FFQ was analyzed using NCI DIETSYS software (National Cancer Institute) modified for use with the Block 95 questionnaire. The computer program reports dietary patterns in the form of food groups (vegetables, fruits, bread/pasta, milk, meat, and fats/oils) and macronutrients (fat [g], carbohydrates [g], protein [g], fiber, percentage fat, percentage carbohydrates, percentage protein, percentage alcohol), as well as other nutrient information (cholesterol [mg] and number of alcohol beverages drunk/day, etc).

Fitness/physical activity. An exercise physiologist conducted the Queens College 3-minute Step Test to estimate VO_2max.[15] The actual step used during testing was 16.25" high, and participants were instructed to perform stepping motions to an 88-beats/minute cadence set by a metronome. The exercise physiologist measured recovery heart rates from 3 minutes 5 seconds to 3 minutes 20 seconds.

Participants completed the Baecke Questionnaire of Habitual Physical Activity (BQHPA).[20] The BQHPA consists of 4 dimensions: work, sport, leisure time, and total physical activities. The questionnaire consists of 21 items scored on a 5-point Likert type scale from "never" to "always" or "very often." Participants were instructed to recall their leisure, sport, and occupational physical activity habits in the previous 4 months. During the posttest, the survey assessed leisure, sport, and occupation physical activity habits of the first semester. For the 2 most frequently reported sports activities, additional questions were asked about the number of months/year and hours/week of participation. Baecke[20] found that level of education was negatively related to work activity and positively related to leisure-time activity. Test-retest reliability was satisfactory for the work (r=.88), sports (r=.81), and leisure (r=.74) indices.[20] Positive relationships have been found with accelerometer readings, oxygen consumption, and activity diaries and the BQHPA.[21,22]

Self-efficacy. Participants completed the Sallis Exercise and Nutrition Self-Efficacy Questionnaire (SENSQ).[23] The SENSQ has been validated with young adults (M=36.0, SD=7.0) and college students and staff (M=21.3, SD=6.5). The SENSQ has 12 self-efficacy for exercise items loading on 2 factors called resisting relapse and making time for exercise and 61 self-efficacy questions for eating-behavior items loading on 5 factors called resisting relapse, reducing calories, reducing salt, reducing fat, and behavioral skills. The SENSQ was adapted for the freshman women in this study who lived in residence halls and not in a "free-living" environment. Items were selected based on their applicability to the problem and population, and whether the item had a high initial factor loading on the SENSQ. There were a total of 26 items selected, 7 exercise and 19 nutrition. Participants were instructed to recall behaviors during their final semester of high school.

Principal component factor analyses were conducted on the adapted SENSQ (referred to hereon as the ASENSQ) to identify subscales. Criteria for item inclusion were as follows: (a) ≥3 items/factor, (b) ≥.4 factor score for each item, (c) eigenvalue ≥1, and (d) communality ≥.50.[24] Factor analyses resulted in 3 factors containing a total of 13 items. Factor 1 (exercise relapse/making time for exercise) consisted of 5 items. Factor 2 (nutrition resisting relapse) consisted of 4 items. Factor 3 (reducing salt/fat) consisted of 4 items. The results of the factor analysis conducted on pretest data (n=82) indicate that factor 1 scores were from .75 to .88, factor 2 scores from .71 to .81, and factor 3 scores from .62 to .78. The criterion for Cronbach alpha was a value ≥.70.[24] The Cronbach alpha values for factors 1, 2, and 3 and the total scale were .90, .80, .72, and .83, respectively. The original item numbers from the SENSQ[23] from Table 1 for factor 1 are 2, 3, 4, 8, and 12 and from Table 2 for factor 2 are 2, 3, 4, and 5 and from Table 2 for factor 3 are 37, 40, 46, and 50.

Research Design and Statistical Analyses

The research design was a pretest/posttest one-group design,[25] and the sampling method was a nonprobability convenience sample. Sample bias was evaluated by comparing pretest data of returnees (n=54) to pretest data of nonreturnees (n=28). Sample representativeness was estimated by comparing the sample to university population and large national studies. Variables used to estimate sample representativeness and sample bias in comparison to the total campus population included the following: age, race/ethnicity, marital status, body weight, body composition, BMI, recovery heart rate, VO_2 max, caloric intake, and total self-efficacy. The statistical test used depended on the scale of measurement of the variables being compared and whether interval/ratio data violated parametric assumptions. Generally, the analyses conducted were as follows: independent/dependent student's t tests for parametric variables, a Mann-Whitney U nonparametric test when the data were ordinal and independent, and a Wilcoxin paired sign test when the data were ordinal and dependent. Statistical analyses were computed using SPSS 10.0.[26]

The following steps were taken to examine parametric assumptions: (a) Descriptive statistics were calculated to note the relationship of the M, Med, and Mod as an indication of skewness; (b) a variety of graphics were computed such as scatterplots to detect outliers as a preliminary way to visually examine distributions; and (c) data were analyzed for normality (skewness and kurtosis) using the Kolmogorov-Smirnov test with a Lilliefors significance correction and homogeneity of variance by the Levene Test for Homogeneity of Variance.[26] When parametric assumptions were not met, variables were analyzed using nonparametric statistics appropriate for the data being reduced in scale of measurement.

RESULTS

Sample Representativeness Estimation

Self-selection bias was estimated with usable data for returnee (n=52) and nonreturnee (n=28) subgroups. The initial body weight, body composition, BMI, fitness level, and total self-efficacy were compared. Although the body weight of the returnee group was significantly higher, U (80) = 503.5, P=.014, other variables (BMI, % body fat, caloric intake, and predicted VO_2 max), representing a more accurate estimate of epidemiologic risk[27] and body composition indicated the effects of the selection bias were nonsignificant, U (80)=599.5, P=.126; t (80)=.835, P=.406; t (78)=.314, P=.755. There was no significant difference either between predicted fitness level and self-efficacy of returnees and nonreturnees, t (79)=1.44, P=.153; U (80)=646, P=.340, respectively. There also were no significant differences for any of the other variables presented in Table 1.

Nationwide, 20.5% of college students are overweight and obese.[3] Data from the present study indicate 14.63% are overweight (BMI [kg/m^2] 25.0-29.9), and 4.88% are obese (BMI ≥30). However, when the overweight and obesity categories are combined, 19.51% of the participants are represented, which is ~1% below the national average.[3] In addition, 46.4% of collegiate students participating in the Youth Risk Behavior Surveillance (YRBS) reported attempting to lose weight at the time of the survey.[3] In the present sample, 22.7% of the participants reported attempts to lose weight on 1to 2 occasions, 13.9% on 3 to 5 occasions, 5.0% on 6 to 8 occasions, 1.2% on 9 to 11 occasions, and 9.2% on ≥12 occasions. All of these values total 42.0%, so the difference between

Table 1
Pre- And Posttest Energy Equation Assessments of Participants (n=54)

	Pretest		Posttest	
	M	SD	M	SD
Variable	**Body Parameters**			
Body Weight (lb)	140.46	25.01	142.05**	25.15
BMI[a]	23.64	3.86	23.91**	3.88
Body Composition (% Fat)	21.96	5.65	23.75***	5.41
Fat mass	31.97	14.42	34.86***	14.80
Fat-free mass	108.84	13.15	107.49**	12.62
	Dietary Intake[b]			
	Food Servings			
Total caloric intake	2205.44	877.85	1856.66***	680.60
Vegetables	2.30	1.18	1.96**	1.02
Fruits	1.52	1.00	1.23	.78
Bread, pasta	2.78	1.15	2.17***	.83
Milk	3.06	1.73	2.53*	1.45
Meat	1.85	.80	1.51**	.70
Fats, oils	2.36	1.63	2.08	1.24
	Nutrient			
Fats (g)	68.84	40.12	60.64*	31.74
Carbohydrates (g)	301.96	113.43	248.78***	88.23
Protein (g)	92.96	31.63	77.63*	35.54
% Fat	27.90	7.01	29.00*	8.23
% Carbohydrate	55.23	6.89	54.98	8.40
% Protein	17.28	2.42	16.77	2.59
% Alcohol	.25	.74	1.23*	2.11
Cholesterol (mg)	240.65	151.75	194.73**	105.63
Alcohol (# of beverages/day)	.04	.10	.16*	.30
	Fitness/Physical Activity[c]			
Recovery Heart Rate	143.76	17.86	146.30	15.67
VO_2max	39.24	3.23	38.79	2.89
Leisure	2.86	.76	3.13*	.60
Sport	3.47	1.16	3.00*	1.25
Occupational	3.17	.78	2.62***	.55
Total Physical Activity	9.51	2.03	8.75*	1.73

Note.
*** P=.05; **P=.01; ***P=.001**
a BMI = (w)kg/(h)m²
b Based on Block Food Frequency Questionnaire.[18]
c Based on Baecke Questionnaire of Habitual Physical Activity.[20]

these data and the YRBS is a negligible 4.4%.

Subjects also represented the incoming freshman class well in terms of ethnicity, marital status, and age. The entire incoming freshman class was composed of the following racial background: 88.81% white, 3.66% Asian, 3.38% African American, 2.23% Spanish, 1.64% international students, and .28% American Indian. All but one of the incoming class were unmarried (99.93%). The

Table 2
Pretest and Posttest Adapted Sallis Exercise and Nutrition Self-Efficacy Questionnaire (ASENSQ, n=52)

	Pretest		Posttest	
Factor #/Subscale Name	**M**	**SD**	**M**	**SD**
1 – Resisting Relapse: Exercise	16.56	4.53	16.27	4.95
2 – Resisting Relapse: Nutrition	14.94	3.17	14.65	3.12
3 – Reducing Salt/Fat	13.73	3.25	13.82	2.60
Total	45.24	8.34	44.75	8.25

Note.
The adapted SENSQ was reduced to 3 factors based on Principal Component Factor analysis. Factors 1, 2, 3, and total score consisted of 5, 4, 4, and 13 items, respectively. The original item numbers from the Sallis SENSQ[23] from Table 1 for factor 1 are 2, 3, 4, 8, and 12 and from Table 2 for factor 2 are 2, 3, 4, and 5 and from Table 2 for factor 3 are 37, 40, 46, and 50.

university's age breakdowns for the entire freshman class were as follows: age 18=72%; 19=17%; and 17=3%. The variables of age, ethnicity, and marital status show close agreement between the sample and the entire freshman female class on these 3 variables.

According to the third National Health and Nutrition Education Survey (NHANES III),[28] the average caloric intake for freshman female college students (age 16-19 category) is 1963 Kcal/day. In addition, Megel et al[8] concluded that freshman women consume an average of 1835 Kcal/day. The dietary intake of the returnees revealed a caloric intake of 1856.66/day. The present results concur with the findings of Megel et al[8] on the freshman female population and are ~100 Kcal/day apart from the national dataset.

A study conducted at the University of Pittsburgh measured M servings of dietary intake via self-report.[29] The components of the food guide pyramid that were measured included grains; fruits and vegetables; dairy; and meat, fish, and beans.[30] The results of these data revealed that 80.3% of the participants were reporting less than the minimum recommendation for grains. Similarly, 81.7% were deficient in the fruits and vegetables category, 83.3% in the dairy category (age <25), and 35.5% in the meat, fish, and beans categories. The results of the present study are consistent with the values reported by Haberman and Luffey.[29] In addition, both initial M bodyfat and predicted VO_2 max are consistent (within ~1.4% and ~.31 ml/kg/min respectively) with previous studies done on freshmen.[31] The data of the present study seem to be similar to those of other studies as well as large national studies.

Main Analyses

Body parameters. Table 1 presents descriptive statistics and statistical significance for variables related to changes in body parameters, dietary intake, and fitness/physical activity. Twenty of the 27 (74.1%) statistical analyses were significant. Inspection of body parameter variables reveals significant changes in all 5 variables. There were significant gains in body weight, BMI, body composition, and fat mass, and a corresponding significant decrease in fat-free mass. The increase in fat mass and decrease in fat-free mass attests to a reduction in fitness.

Dietary intake. All food servings variables showed decreases, and 5 of the 7 (71.4%) were significant decreases. Total caloric intake significantly decreased by 348.78 Kcal/day, and so did vegetables, bread/pasta, milk, and meat.

In terms of nutrient variables, 7 of the 9 (77.8%) changes were significant. There was a significant decrease in grams of fat, carbohydrates, and protein and percentage fat and milligrams of cholesterol. There were significant increases in percentage fat and alcohol consumed and in the number of alcoholic beverages consumed/day.

Comparisons to recommendations reported by the US Department of Agriculture[30] revealed deficiencies in both pretest and posttest intake of daily vegetables, fruits, breads and pasta, and meats. Participants, however, seem to be consuming adequate amounts of milk.

Fitness/physical activity. Four of the 6 (66.7%) fitness and physical activity analyses were significant. Significant decreases were observed in total physical, work, and sport activities, but there was a significant increase in leisure activities. Both of the fitness variables showed declines, but neither was significant.

Self-efficacy. Table 2 contains pretest and posttest Ms and SDs for ASSEQ factors 1-3 and the total score. Modest nonsignificant decreases occurred for factors 1, 2, and total score, but a modest nonsignificant increase was observed for factor 3.

DISCUSSION

The results of this investigation suggest that when freshman women left home to attend college, body weight increased. Furthermore, dietary energy intake did not increase to account for this increase in body weight; dietary energy intake actually decreased. This suggests that a reduction in physical activity was primarily responsible for the change in body weight, a suggestion supported by a significant reduction in total physical activity, especially occupational and sports-related physical activity. Fat mass increased and fat-free mass decreased, which also suggests a reduction in fitness due to a decrease in physical activity. Although the nonsports leisure index increased, it did not offset the reduction in the other 2 indices. In the pretest, subjects listed a variety of occupations that were commensurate with a high school education; in other words, they were less skilled and more labor-intensive occupations. In the posttest most subjects listed their occupation as "student," meaning that occupational activity consisted primarily of walking to and from classes.

The findings of this study are similar to those of prior investigations that have demonstrated an increase in body weight during the freshman year. Body composition though may be a better indicator of chronic disease risk because bodyfat gain was disproportionate to total weight gain. This increase, accompanied by a reduction in fat-free mass, suggests that energy requirements could be reduced for both physical activity and resting metabolism. The increase in bodyfat represents a reduction from the 50th percentile to the 40th percentile in the 20 to 29 age-group classification, which equates to an elevated increase in health risk.[14]

Another contribution of the study was adapting the Sallis Exercise and Nutrition Self-Efficacy Questionnaire to female college freshmen living in residence halls. Based on the preliminary psychometric results, the adapted questionnaire appears to be a useful adjunct for studying this topic and population. Factor loadings and Cronbach alpha values were computed and comply with acceptable standards for factorial validity and internal consistency.[24] Psychometric estimates need to be further validated in future studies to provide additional perspective about levels of self-efficacy. In accordance with self-efficacy theory,[10] the findings support the stability of residence hall students' confidence to overcome diet and physical activity obstacles because students' perceptions about self-efficacy did not change over time.

The present study may have limitations. The relatively small sample size reduced the minimal power to detect significant differences between the pretests and posttests for some variables. Nevertheless, 74% of the variables assessed and reported in Table 1 were significant. Because diet and physical activity were not observed, self-report bias may have occurred. For example, a higher degree of caloric underreporting occurs with increasing body weight,[31,32] and problems of overreporting time and intensity have been noted with self-report of physical activity.[33] Nevertheless, self-report is the norm in nutritional and physical activity field studies because of practicality and "reasonableness" in terms of time considerations of voluntary study participants. Consequently, self-reported nutrition and activity instruments were the measures of choice in the present study.[33] Because the study measured dietary patterns over a time period of months, the use of dietary tools that predict caloric intake based on 1 to 7-day time periods was inappropriate. In addition, to maximize participation by conducting *in vivo* data collections within participants' residence halls, skinfold assessments for body composition and a step test for aerobic fitness were necessary as field measures. Requiring volunteer participants to be measured in a laboratory setting would have seriously jeopardized recruitment and retention based on prior experiences with conducting studies in residence halls on campus.

The results have programmatic implications. The findings demonstrate that interventions are needed to reverse the upward trends noted in body composition among the female college freshmen in this study and as part of a total effort to reverse the national trend of increasing adiposity. The findings suggest that an intervention to provide guidance about physical activity and diet following a significant change in living arrangements would be beneficial. The focus of the intervention based on the current study results for this sample would be on ways to increase total, leisure, and sport activity as well as the overall quality of the diet. Cautions should be indicated about consuming or increasing alcohol usage and the health consequences as well as engaging in a risky behavior.

This study has implications for future research. Because a greater increase in percentage bodyfat than body weight was observed, body composition may be a more "sensitive" measure and assessment of risk for freshman women. Use of behavioral surveys aids in the identification of specific risk behaviors. Decreases in physical activity patterns appear to be a stronger marker of weight gain than are increases in caloric intake. The further identification of the unique obstacles and opportunities relevant to diet and physical activity is a priority for understanding weight gain in freshman college women who relocate to the university.

In summary, the findings in this sample of female college freshmen supports the assumption of Heini and Weinsier[5] that weight gain in the face of constant or reduced caloric intake is a result of a reduction in habitual physical activity. Results of this study promulgate the need for educational programs in the areas of physical activity, fitness, and diet and may help in designing interventions for freshman women residing in residence halls on college campuses who have relocated and appear to be at risk. ■

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