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Assessing Sleep Quality in Young Adult College Students, Aged 18 - 24 in Relation to Quality of Life and Anthropometrics

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ASSESSING SLEEP QUALITY IN YOUNG ADULT COLLEGE STUDENTS, AGED 18 – 24 IN RELATION TO QUALITY OF LIFE AND ANTHROPOMETRICS

By

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An Abstract of the Thesis Presented
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Little is known about the impact of sleep on quality of life and anthropometrics in young adults. College students (n=218) were recruited through a variety of methods for a study on weight management for obesity prevention and randomized into control (n=108) or treatment (n=110) groups. Of those, 152 (71%) completed pre- and post-tests, including the Pittsburg Sleep Quality Index (PSQI), scored 0-4 =normal and 5-21=disordered, (α=0.80), the General Health Questionnaire-12 (GHQ), scored from 0-14=good quality of life to 15-36=poor quality of life, (α=0.87), and anthropometrics. Statistical analyses included linear regression, one way ANOVA, chi-square analysis, and Pearson's Product-Moment Correlation. Significance was set at a $P \leq 0.05$ level. Dr. Suzanne Shoff provided statistical consulting. Since no significant differences were found for sleep, quality of life, or demographics between treatment and control groups, data were combined for pre-test analysis. Of the total sample, most subjects were white (93%) and lived on campus (75%). For PSQI, 35% had scores ≥5, indicating

disordered sleep quality; for GHQ, 12% had scores ≥15 indicating poor quality of life. As sleep quality became more disordered, post-test BMI increased (P=0.008). For every increase in sleep quality score, BMI increased by β=0.29 (CI=0.08-.5, P=0.008). Disordered sleepers had higher post-test waist circumferences (88.7 cm±8.9 cm) than normal sleepers (81.7 cm±4.9 cm) (P=0.007). As age increased waist circumference also increased (P=0.031) by a factor of β=1.38. Disordered sleep quality was associated with approximately a 400% increased risk of poor quality of life at post-test (OR=4.11, 95% CI=1.6-10.4, P=0.003). For every increase in year of age there was a 57% increase in the risk for a poor quality of life (OR=1.57, 95% CI=1.01-2.46, P=0.045). Quality of life decreased for subjects who got <7 hours of sleep per night (short sleepers) compared to those who slept 7-9 hours per night (normal sleepers) (P=0.005). Regardless of test time there were significant correlations between sleep quality and quality of life, and sleep quality and anthropometric data. Sleep duration was negatively correlated with weight for the total sample and specifically for males (p=0.01). Based on the findings from this study, sleep should be addressed in wellness programming on university campuses, including its long-term implications on health.

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Chapter 1

INTRODUCTION

Young adults beginning college are entering a world of new experiences and choices. Based on the choices they make, their college experience can contribute to a health- or disease- promoting lifestyle and ultimately relate to their quality of life. Choices contributing to excessive weight gain are especially concerning because of the increase in obesity in the United States (1) and obesity-related chronic diseases (2). Based on epidemiological studies (3-5), young adults are at a critical period for adverse changes in body weight to occur. Being mildly or moderately overweight between ages 20-22 years is linked with substantial incidence of obesity by age 35-37 years (6, 7).

While the causes of obesity are multi-factorial (8, 9), recent work on behavioral influences, like sleep duration and quality, is particularly interesting when considering lifestyle choices and quality of life issues. A correlation has been found between sleep duration and risk factors for obesity (10) and diabetes (11) in adults. Nutritional well being and a higher quality of life have been studied in older adults, and there is a correlation between the two (12). Based on population curves, it is expected that there will be a similar correlation seen in other demographic groups.

The goal of this study was to identify the sleep quality of young adult college students and the relationship with other health behavior. The students were participating in an obesity prevention intervention focused on healthful eating and physical activity. Sleep quality and factors affecting sleep quality were assessed at pre-test and post-test.

Chapter 2

LITERATURE REVIEW

Sleep – Overall Importance

Almost every species requires sleep, and humans, on average, spend one-third of their life asleep. It is reported that sleep is "food for the brain" (13). When sleep quality and/or duration are reduced, the human body responds in many ways to initiate sleep. To initiate sleep the brain will increase feelings of "sleepiness", decrease a person's ability to concentrate, and in extreme cases may, without warning, force the body to sleep. Lack of sleep contributes to reduced concentration, short-term memory, learning ability, and behavioral self control. Additionally, researchers at the National Institute of Health (14) have reported that decreased sleeping may lead to a decrease in total lifespan. When deprived of quality sleep, rats, whose typical lifespan is 2 to 3 years, have their life duration reduced to as little as 3 – 5 weeks. A person's general health habits, including sleep, have many direct effects on one's life. In 2000, Trockel and colleagues (15) examined health-related variables in respect to academic performance in the first-year college population. The researchers found a negative impact on cognitive performance. Students from a private university (n=189) were asked to fill out a brief questionnaire and identify their semester grade point average (GPA). There was a significant positive relationship between GPA and studying spiritually-oriented

material (r = 0.238) and eating breakfast (r = .241) based on a Spearman's correlation ($p \leq 0.05$). GPA was negatively related to later weekday wake-up (r = -0.350) and increased number of hours worked per week (r = -0.158). The less a person slept the greater the negative impact on GPA.

In 2003 Yang and colleagues (16) stated that "sleep disturbance is one of the most common health complaints among late adolescents and young adults". The researchers had first-year Taiwanese students (n=1,992) complete the Pittsburgh Sleep Quality Index (PSQI). Based on any score >5 being indicative of sleep disturbances, the researchers found that 44% of the students had a mean PSQI score of 6.2±2.5. For those subjects with sleep problems, the researchers found that the most common reason was insufficient sleep (57%). Difficulty with falling to or maintaining sleep was reported by 14.4% of the sample. From 5.7% to 8.9% reported factors such as daytime sleepiness, erratic sleep schedule, poor sleep quality, personal snoring, and nightmares. The reported conditions decreased overall sleep quality and/or duration.

Sleep Duration and Health Risk

In 2007 Stamatakis and Brown (10) examined the correlation between sleep duration and obesity-related risk factors. The researchers examined the sleep and other factors of 1,203 people living in Missouri, Tennessee, and Arkansas, using the Behavioral Risk Factor Surveillance System Instrument. The subjects were separated into the following groups based on sleep duration: <7 hours – short sleep time, 7 – 8 hours – normal sleep time, >9 hours – long sleep time. The researchers found that the subjects that had short sleep time had many more risk factors for obesity than normal sleepers.

More short sleepers did not meet the recommendation for exercise and fruit/ vegetable consumption when compared to "normal" sleepers. Additionally, more short sleepers consumed diets higher in fat and often consumed fast food. It is interesting to note that long sleepers scored very similar to the short sleepers. In regards to body mass index (BMI), a measure of weight in relation to height, 31.9% of the short sleepers, 26.4% of normal sleepers, and 46.2% of long sleepers had a BMI that classified them as obese, >30. (p=.02)

In 2006 Gangwisch and colleagues (11) researched the effect that sleep duration had on the risk factors for diabetes. There were 8,992 subjects that were followed for 10 years. The researchers reported sleep times as ≤ 5, 6, 7, 8, and ≥ 9 hours. There was a noted increase in the risk for diabetes for the subjects who slept ≤ 5 or ≥ 9 hours per night (Odds Ratio = 1.57 for both at a 95% confidence interval). Thus, a "U" shaped curve was depicted, indicating an increased rate of diabetes at the lower and upper ends of sleep times. Similar observed findings, though not analyzed, in sleep duration were also noted for subjects with hypertension; with 66% of subjects diagnosed with hypertension slept for ≤ 5 hours, 51.7% for 7 hours and 65.2% for ≥9 of sleep.

Characteristics of Young Adults

Young adults (aged 18 – 24) frequently feel misunderstood (17). During young adulthood, people are losing some of the support systems that have helped them throughout childhood. The changing support system is a precursor to a person choosing unhealthful behavior such as drinking alcohol, smoking, and excess food consumption (1). This age group often views themselves as being invincible (18), which leads to living

as if life choices have no consequences. Excess consumption of food and alcohol may be common and can lead to increased risk for weight gain (16, 18). Increased weight gain during this stage of life often leads to lifelong issues with hypertension, hyperlipidemia, and diabetes (7, 10 ,19)

Young adults are entering a new phase where their choices are usually much less controlled by parents or family members, but still influenced strongly by their peers and the mass media. Body image is often a huge concern for both males and females, and perceived body image can lead to disordered eating (20-23). During this time, young adults are also free to experiment with their sexuality. Sexual experimentation can lead to concerns about disease and/or pregnancy. This stress can lead to increased eating (24).

In 2003, Anderson and colleagues (25) performed an initial evaluation of weight gain during the first semester of college. Subjects were weighed in September and December (n=145). Some of these subjects were weighed again in May (n=46). When the subjects' weights were obtained, they were wearing lightweight street clothes. The researchers found that 26% of the subjects gained more than 2.3 kg from September to December. 14% of subjects had been reclassified to an overweight or obese BMI by December while 86% of those subjects remained in the normal BMI range. Out of the subjects that stayed in the study from December to May, 13% showed a weight gain of >4.5 kg and 22% of the subjects with normal BMIs in September had BMIs that were indicative of overweight/obese.

Betts and colleagues (26) researched the different ways young adults viewed food, and in turn, their food choices. The subjects in this study ranged in age from 18 – 24 (n=1,475). The subjects were categorized into three groups: current college students (n=736), college graduates (n=237), and nonstudents (n=328). The researchers mailed a survey that included demographics, opinion items, and a food rating grid. The researchers found that while students viewed foods as health-promoting or fattening, when making food selection, these views were ignored. To the young adults, convenience and lack of food preparation skills were often reported as more important than nutrition. Among the non students the satiety factor of food was an important factor considered when making food choices. The researchers concluded that although the importance of healthful food is known to the young adult population, education needs to be tailored to the perceptions associated with a specific group, rather than toward the healthfulness of food.

The Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) was developed in 1988 by Buysse and colleagues (27) to provide a standardized measure of sleep quality and the factors that influence quality. The researchers' objectives were to provide a reliable, valid, and standardized measure of sleep quality, an index that is easy for subjects to use and interpret; a brief, clinically useful assessment of a variety of sleep disturbances; and to

be able to discriminate between "good" and "poor" sleepers. The PSQI is based on eighteen self-reported questions about the person's own sleep quality, and if the person has a roommate, there are five additional questions which can be completed by the roommate.

The eighteen questions provide the basis for seven rated components, including subjective sleep quality, sleep latency, habitual sleep efficiency, sleep duration, use of sleeping medication, sleep disturbances, and daytime dysfunction. Subjective sleep quality is determined by asking how sleep quality has been over the past month. Sleep latency is determined by identifying the length of time to fall asleep. Habitual sleep efficiency comes from the percent of time asleep vs. time in bed. Sleep duration is based on the usual number of hours of sleep per night. Use of medication is determined by asking if medication has been used to help sleep in the past month. The sleep disturbance component is based on a variety of things that may disturb sleep like having bad dreams and pain. Daytime dysfunction is determined by asking questions like whether one has the ability to stay awake in class and to have enthusiasm for activities.

To score the questionnaire, each of the individual questions is assigned a score from 0 – 3. The item scores are used in computing the seven component scores, which are then added to produce a global score. The global score can range from 0 to 21. Any total score obtained that is greater than 5 is suggestive of a significant sleeping disorder. Unlike the overall score, there are no reported "cutoff" scores for the seven components.

When the PSQI was first introduced, Buysse and colleagues (27) tested the validity of the tool in an 18 month study that consisted of 148 subjects separated into three groups. The control group (n=52) of healthy subjects, a group of subjects with diagnosed sleep disorders (n=62), and a group with depression (n=34). The control group had a mean score of 2.5 with a range from 0 through 8. The group of subjects with depression had a mean score of 11 with a range from 2 through 20. The group of subjects with a sleep disorder had an average score of 9.5 with a range of 2 through 18. When the variable groups (sleep disorders and depression) were compared to the control group (healthy subjects), the PSQI showed a sensitivity (the probability of identifying a person with the condition) of 89.6% and a specificity (the probability that someone without the condition will test negative) of 86.5%. In total, the cutoff score of 5, as an indicator of sleep disorders, was accurate in identifying 88.5% of all the subjects.

In 1996, Carpenter and Andrykowski (28) preformed a psychometric evaluation of the PSQI. There were 472 total subjects that completed this study. The subjects consisted of four different classifications; there were male and female bone marrow transplant recipients (n=155), male and female renal transplant recipients (n=56), women with breast cancer (n=102), and women with benign breast problems (n=159). The researchers chose these conditions due to their predisposition for fatigue and other sleep disturbances. The average scores of bone marrow transplants were 6 ±4.3 for women and 5.4 ±3.6 for men. Renal transplant patients scored higher with women averaging 7.9 ±4.5 and men averaging 7.3 ±4.3. For both of the previous groups, there

was little variation between men and women in relation to their component scores. The final two groups scored between the prior with women with breast cancer scoring an average of 7.0 ±4.4 and women with benign breast problems scoring 6.4 ±4.2. They reported a Cronbach's alpha coefficient of 0.80, indicating a mildly strong coefficient. There was a moderate to high correlation between subjects' reports of sleep problems and the measures of sleep quality. Subjects reporting sleeping difficulties had higher scores than subjects reporting no problems sleeping. The researchers concluded that the PSQI appeared to be strong psychometrically and useful for a variety of populations.

In another study completed by Backhaus and colleagues in 2001 (29), the test-retest reliability, as well as validity, were also examined. There were 125 total subjects in two groups; a group of subjects with a diagnosis of primary insomnia (n=80) and a group of subjects with no reported sleeping disturbances (n=45). The mean overall score for the group with insomnia was 12.5±3.8, while the control group had a mean score of 3.3±1.8. In order to determine the re-test reliability the researchers used an interval of two days or several weeks. The researchers determined a reliability coefficient of 0.87, indicating that 87% of the time the score obtained was accurate, while the remaining 13% consisted of error. When the PSQI survey results were compared with sleep logs, there was a sensitivity of 98.7%. The specificity reported was 84.4% in determination of sleep disturbances in the subjects with primary insomnia versus the control group. The researchers discussed that, in their study, if the cutoff was

increased to 6, specificity would increase to 100% and a slight reduction in sensitivity of 93.4%. All of the results provided by Bachhaus and colleagues used 5 as the cutoff; however, they stated that more research should be completed to determine if the cutoff should be changed to 6.

In 2006 Aloba and colleagues (30) researched the validity of the PSQI using university students in Nigeria. This study included 520 university students with an average age of 23.24 years. These subjects were asked to complete the PSQI and the General Health Questionnaire, a measure of quality of life. Upon completion of the surveys, each subject was interviewed and a sleep diagnosis was provided based on the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (31) and the International Classification of Sleep Disorders, revised criteria (32). The average global PSQI score was 4.43 ±2.67. When compared to the diagnostic criteria, the PSQI had a sensitivity of 72% and a specificity of 54.5% at a cutoff score of 5. The researchers concluded that the significant difference in the sensitivity and specificity from previously published studies could have been due to cultural differences (Western v. Non-Western) in what constitutes "good" sleeping habits/abilities.

Quality of Life and General Health Questionnaire (GHQ-12)

Quality of life is an important factor in every individual's life. Tools have been developed to measure quality of life (33, 34). Concepts that are associated with quality of life include ability to sleep, amount of perceived stress, feeling useful and happy, and ability to enjoy everyday activities (33). Quality of life is a subjective state that depends on how an individual perceives their life situation and what is important to them. For all

people quality of life is based on a state of psychological well being and a feeling of overall happiness (35). Researchers have reported that there is a distinct difference between psychological/mental and physical quality of life. Mental quality of life is the belief that a person can accomplish something, while physical relates to the ability to do it. Zahran and colleagues found that young adults aged 18-24 reported more mentally unhealthy days than physically unhealthy ones (36).

The General Health Questionnaire (GHQ-12) has been found to be a reliable method to measure quality of life (33). The General Health Questionnaire consists of two factors, based on principal component analysis. These factors are social dysfunction and psychological distress, or dysphoria (characterized by a general mood of depression, or feelings of malady) (28, 33). There are seven items that are associated with social distress including the ability to concentrate, being useful, and enjoying normal activities. Psychological distress is determined by six items that include loss of sleep, inability to overcome difficulties and enjoying normal activities. The item "enjoy normal activities" loaded on both factors.

The GHQ-12 can be scored in two ways (37). Each item has four choices which can be scored as 0,0,1,1 or 0 – 3. The first scoring method generates a maximum score of 12. When scoring is done in this way a score of <4 is indicative of an average to good quality of life. When scored in the second manner, a maximum score of 36 is generated. A typical score of 11-12 indicates an "average" quality of life. A score of >15 suggests evidence of personal distress. A score of >20 is indicative of extreme psychological distress.

Montazeri and colleagues (33) tested the validity and reliability of the GHQ-12 in 2003. The researchers had 748 subjects aged 18 – 25 complete the GHQ-12. The researchers tested internal consistency by using Cronbach's alpha. They found the alpha to be 0.87 for the total sample and for both sexes. Validity was tested by using the correlation between the instrument and a validated measure of global quality of life (34). There was a significant negative correlation (α=-0.56), that is, those with higher scores (more distress) on the GHQ-12 had lower scores on global quality of life. The mean score of the subjects was 3.7 ±3.5, indicating "good" quality of life. The researchers determined the GHQ-12 to have both a relatively strong validity and reliability and useful for determining a person's quality of life.

In 2007 Toyabe and colleagues (38) used the GHQ-12 to determine the quality of life of Japanese nationals (n=2,107) who had survived an earthquake, measuring 6.8 on the Richter Scale. The GHQ-12 was administered twice, once five months after the earthquake and again two years following the earthquake. After subjects completed the questionnaire, the researchers found that social dysfunction scores were initially, on average, lower than dysphoria scores. However, after two years, social dysfunction scores were only slightly down, while dysphoria scores had dropped considerably. The researchers reported a high reliability coefficient ranging from 0.87 – 0.90. It was noted that this study had no group to compare the results to since all the Japanese population had experienced the earthquake.

Chapter 3

METHODOLOGY

Goal and Objectives

The goal of this study was to identify the sleep quality of young adult college students and its implications on other health behavior. The specific objectives were to:

1. assess sleep quality in young adult college students aged 18 – 24 from pre-test to post-test,
2. assess the relationship between:
    a. sleep and anthropometrics,
    b. sleep and quality of life indicators
    c. sleep quality and selected demographic data, and
3. assess the relationship between quality of life and anthropometrics

Study Design

The design of this research is a longitudinal study with assessments at pre-test and post-test. Sleep behavior, general health and anthropometric measurements were conducted. The UMaine Sleep study was part of an 8-state study, designed to test whether a 3-month, online nutrition and physical activity intervention could reduce the rate of weight gain over the study period compared to a control condition. It was an experimental design with random assignment to groups. Informed consent was initially obtained online and when subjects were seen for pre-test anthropometric measurements, they were asked specifically about their willingness to participate in the sleep study portion of the project. Approval for this study was granted by the University of Maine Review Board for the Protection of Human Subjects.

Subjects

All subjects (n=218) were 18-24 year old college students from the University of Maine. To be included in this study the students must have met the requirements for the 8-state study, including age, year in college (full-time freshmen, sophomore, or junior), and ability to access the Internet. In addition to the inclusion requirements, students with severe illness, pregnancy, or working towards a degree in the Department of Food Science and Human Nutrition or Kinesiology and Physical Education were excluded from this study.

Study Protocol

A convenience sample of college students (n=225) was recruited through freshman orientation meetings, large entry-level classes, posting notices on FirstClass, the University of Maine's email system, and flyers in dorms, Union, computer centers, and the recreation center during Fall 2007. Students were directed to the study website, developed by another researcher, to give consent for participation, complete the General Health Questionnaire (GHQ-12) (Appendix A), demographic form (Appendix B), and make appointments for the physical assessment. The Pittsburgh Sleep Quality Index (PSQI) (Appendix C) was administered in paper and pencil format when subject came to the Nutrition Education and Behavior Laboratory in Hitchner Hall for physical assessments. At this time, students were informed about the option to complete the PSQI when reading and signing the hard copy consent form (Appendix D).

Training

Training for the researcher occurred during the spring and summer of 2007. This process included reviewing both study protocol (39) and assessment protocol manuals (40), viewing a Digital Versatile Disk (DVD), created for instructional purposes, and observing and conducting practice assessments. The researcher was verified by the primary investigator before conducting the students' assessments.

Inter-rater reliability was computed for this researcher and the rest of the assessment research team. In the fall of 2007 inter-rater reliability for assessing height was r=0.9997. The reliability for weight was r=1.0. For the fall of 2008 inter-rater reliability was r=0.9435 for height and r=1.0 for weight.

Subject Incentive

For participation in the 8-state study, incentives were given at the completion of each physical assessment period, amounting to $10 at pre-test and $25 at the post-test assessment. No additional incentive was provided for completion of the sleep questionnaire.

Instruments

The following instruments were administered at pre-test and post-test. Copies of each instrument can be found in the appendixes as stated below:

Pittsburg Sleep Quality Index (PSQI)

Aspects of sleep such as quality and quantity were assessed using the Pittsburg Sleep Quality Index (α=.80) (Appendix C) (27). The PSQI is based on eighteen self-reported questions; measuring the components of: subjective sleep quality, sleep

latency, habitual sleep efficiency, sleep duration, use of sleeping medication, sleep disturbances, and daytime dysfunction. The score from each category is added to achieve a global score that ranges from 0 – 21. A cutoff score of 5 or above is indicative of a sleep disturbance.

General Health Questionnaire (GHQ-12)

The General Health Questionnaire (α=.87) has 12 items and is used as a self-reported measure of social and psychological well-being (Appendix A). The reliability and validity of the instrument have been reported by Montazeri et al (33). It is being used as an indication of quality of life. This researcher used a maximum score of 36. A typical score of 11-12 indicates an "average" quality of life. A score of >15 suggests evidence of personal distress. A score of >20 is indicative of extreme psychological distress. For the purposes of this study a cutoff point of 15 will be used. Subjects with scores <15 will be considered as good quality of life and subjects with scores ≥15 will be considered as poor quality of life.

Demographic Questionnaire

Demographic information was collected using a 16 question online form (Appendix B). Most of the questions have been previously used when working with the young adult population.

Physical Assessments

During each physical assessment, measurements were taken for height and weight. This researcher was trained on all protocols and conducted the physical assessments at each time period. A data collection form (Appendix E) was used to collect all data.

Body Weight

Weight was measured using a calibrated Healthometer Professional digital scale. Students were asked to fast for 4 hours, void, wear light clothing, and remove their shoes before being weighed. Each student was weighed twice with each weight being recorded to the nearest 0.2 lb. If one weight was not within 0.2 lb of the other, a third weight measurement was obtained. The two (or three) weights were averaged and the average recorded. For the post-test assessment, subjects were asked to schedule their appointment at approximately the same time of day, and to wear similar clothing, as the pre-test assessment.

Height

Height was measured using a 222 Seca stadiometer following the weight measurement. Students kept their shoes off for this measurement. Students were required to remove any hair accessories (i.e. clips) or hair styles (i.e. buns) that would alter the height measurement. Students were asked to stand with the center back on the stadiometer with a total of four points of contact. Heels, buttocks, back of the head, and scapula were all to be in contact with the wall. The top of the stadiometer rested firmly, but not pressing hard, on the top of the head; students were then asked to inhale

and exhale to stabilize their height. Two measurements of height were obtained. If the two measurements differed by more than 0.125 of an inch a third measurement was obtained. The stadiometer used was read at chest level. The two (or three) measurements were averaged and recorded on the data collection form and then transferred to an online data management website.

Body Mass Index (BMI)

Using the average height and weight measurements, each student's BMI was obtained. BMI was automatically determined when the height and weight were entered into the online data management system.

Statistical Analysis

General descriptive statistics were generated. To test for associations between continuous variables Pearson's Product-Moment Correlation was used. Analysis of variance (ANOVA) and *t*-tests will be used to test for group differences, while Chi-Square will be used to test for differences in categorical variables. Logistic regression was run to generate odds ratios. The probability level was set at $p \leq 0.05$. Statistics were generated by the researcher and by Dr. Suzanne Shoff, a member of the multistate team. She served as the statistical consultant.

Chapter 4

RESULTS

During the recruitment phase of Project WebHealth, 225 subjects were recruited. Of these initial subjects, 218 completed the Pittsburgh Sleep Quality Index at pre-test. The pre-test sample (n=218) demographics are shown in Table 1.

Pre-Test Results

General Descriptive Characteristics

The subjects were predominately white (92.66%), living on campus (73.27%), and under the age of 21 (96.32%). Subjects were evenly divided by gender (male=50.5%; female=49.5%) and year in school from first-year (32.6%), to sophomore (35.8%), to junior (31.2%). All six colleges from within the University were represented in the subject pool. Only 11% of the subjects had completed a college level nutrition course. Gender differences were not seen in pre-test characteristics. No differences in sample demographics were noted at pre-test for subjects who completed both pre- and post-tests (n=152) when compared to those who did not complete the study.

No significant differences were found for sleep, quality of life, or demographics between treatment and control groups. Therefore, data were combined for pre-test presentation.

Table 1: General Descriptive Characteristics of Sample at Pre-Test

	Males		Females		Total	
	n	*(%)*	*n*	*(%)*	*n*	*(%)*
Total Sample[1]	110	(50.50)	108	(49.50)	218	(100.00)
Age (years)						
18-19	65	(59.09)	73	(67.59)	138	(63.30)
20-21	40	(36.36)	32	(29.62)	72	(33.02)
22-23	5	(4.54)	3	(2.77)	8	(3.66)
Race[2]						
White	103	(93.63)	99	(91.66)	202	(92.66)
Non-White	7	(6.36)	9	(8.33)	16	(7.33)
Residence[3]						
On-Campus	81	(73.60)	78	(72.22)	159	(73.27)
Off Campus	29	(26.40)	29	(26.85)	58	(26.62)

[1]When n≠ 218 the difference is due to non-responders
[2]Non-white: n=8 Not Reported, 3 Asian, 2 Other, 1 each Black, Hispanic, Native American
[3]Response based on current life situation

Overall, the mean weights were 172.88±31.16 lb. for males and 145.49±33.6 lb. for females. The majority of the sample (69.3%) had a body mass index (BMI) that fell within the normal category. In Table 2 are the anthropometric data (mean±sd) by BMI category. Weight, BMI, and waist circumference differed by category (p=0.001). Within each category, gender differences were noted for weight (p=0.001) and waist circumference (p=0.026), with males having higher values than females. Based on health risk cut offs for waist circumference at 88 cm for women and 102 cm for men, more women (n=26) than men (n=6) were identified as at risk (p=0.001). All men at risk

fell within the obese categories; however women at risk were classified as both overweight and obese. Waist circumference was seen to increase as age increased in both the total population (OR=1.43, CI=1.03-2.02, p =0.03) and in men (OR=1.38, CI=0.08-2.66, p=0.03).

Table 2: Anthropometric Characteristics at Pre-Test[1]

	Body Mass Index (BMI) Category		
	Normal (18.5-24.9) mean±sd	**Overweight (25-29.9)** mean±sd	**Obese (>30)** mean±sd
Males	*n= 75*	*n= 27*	*n= 8*
Weight (lb)	159.93±16.51[2,3]	188.22±17.8	242.54±53.71
Height (in)	68.16±3.56	67.73±3.35	70.73±2.87
BMI	22.62±1.55	26.82±1.51	33.66±5.54
Waist Circumference (cm)[4]	79.82±5.14[5]	89.83±5.43	108.19±13.82
Females	*n= 76*	*n= 21*	*n= 11*
Weight (lb)	129.91±15.32[2]	163.55±16.64	218.69±36.96
Height (in)	67.27±3.97	67.50±4.30	66.97±3.77
BMI	21.65±1.60	27.14±1.34	35.84±5.57
Waist Circumference (cm)[4]	75.71±6.41[5]	87.92±6.25	104.73±12.09

[1]Total Sample = 110 Males, 108 Females

[2]Significant differences for weight, calculated BMI, and waist circumference across BMI categories (P=0.001).

[3]Significant difference for weight(p =0.001) within gender.

[4]Health risk cutoff is 102 cm for men and 88 cm for women.

[5]Significant difference for waist circumference (p =0.026) within gender

Sleep Quality and Quality of Life at Pre-Test

Table 3 shows the Pittsburgh Sleep Quality Index (PSQI) (sleep quality) and General Health Questionnaire (GHQ-12) (quality of life) scores. Overall the global PSQI score was 5.36±2.70, just slightly above 5, the designation for normal sleep. When the sample was categorized by normal (PSQI≤ 5) and disordered (PSQI>5) sleepers, mean scores differed for normal sleepers (3.74±1.18) and disordered sleepers (5.36±2.70)

(p=0.001). On average, these college students reported sleeping 7.49±1.13 hours/night. Sleep duration also differed for normal and disordered sleepers. Normal sleepers reported sleeping a mean of 7.82±0.965 hours/night and disordered sleepers reported 6.92±1.17 hours of sleep/night (p =0.001). The General Health Questionnaire (GHQ-12) mean score was 10.26±4.44 for the total sample, indicating a good quality of life overall. Males (9.74±3.78) reported significantly lower GHQ-12 scores, indicating a higher quality of life, than females (10.81±4.99) (p=0.009). GHQ-12 scores were significantly different based on year in school (p=0.03). As year in school increased, quality of life decreased. Normal sleepers had lower GHQ-12 scores than disordered sleepers (p=0.007).

Table 3: Sleep Quality and Quality of Life at Pre-Test

	Males mean±sd	**Females** mean±sd	**Total** mean±sd
	n=110	n=108	n=218
Pittsburgh Sleep Quality Index (α=0.80)[1]			
Global Sleep Score			
Normal Sleepers (n=153)	3.74±1.18[2]	3.76±1.16	3.75±1.16
Disordered Sleepers (n=65)	5.21±2.72	5.52±2.69	5.36±2.70
Sleep Duration (hours)			
Short Sleepers (<7 hours) (n=26)	6.00±0.60	6.27±0.33	6.09±0.54
Normal Sleepers (7-9 hours) (n=161)	7.52±0.619	7.41±0.617	7.47±0.619
Long Sleepers (>9 hours) (n=27)	9.35±0.58	9.39±0.55	9.37±0.55
General Health Questionnaire (α=0.87)[3]			
Total Score	9.74±3.78[4]	10.81±4.99	10.26±4.44
Good Quality of Life (<15) (n=176)	8.68±2.76	8.47±2.93	8.52±2.84
Poor Quality Of Life (≥15) (n=32)	16.64±1.74	17.43±4.63	17.1±3.79

[1]Measures Sleep Quality Score Range= 0 - 21; ≤5= normal sleep quality, 6 - 21= disordered sleep (Buysse et al, 1989).

[2]Significant differences between normal and disordered sleepers for males, females, and total (p =0.001).

[3]Measures Quality of Life - Score range = 0 - 36; <15=good quality of life, ≥15=poor quality of life (Montazeri et al, 2003).

[4]Significant difference by gender (p =0.009) within good quality of life.

A factor contributing to the measure of sleep quality is incidence of sleep disturbances. Table 4 shows the mean±sd and frequencies of sleep disturbances that affected the sample based on the number of times over the "past month". The most frequently reported disturbances were "cannot get to sleep within 30 minutes" (p=0.001) and "wake up in the middle of the night or early morning" (p=0.001). Males more frequently reported experiencing these two disturbances (p=0.001). Sleep disturbances were not affected by living situation, age, or work/credit hours.

Table 4: Reported Sleep Disturbances at Pre-Test (n=218)

		not during the past month		less than once a week		once or twice a week		three or more times a week	
	mean±sd	n	%	n	%	n	%	n	%
During the past month, how often have you had trouble sleeping because you…	.	.	.	.	.	.	.	.	.
Cannot get to sleep within 30 minutes	1.17±0.92	53	*24.65*	94	*43.72*	46	*21.40*	22	*10.23*
Wake up in the middle of the night or early morning	1.28±0.99	57	*26.51*	66	*30.70*	66	*30.70*	26	*12.09*
Have to get up to use the bathroom	0.67±0.85	115	*53.49*	65	*30.23*	26	*12.09*	9	*4.19*
Cannot breathe comfortably	0.18±0.48	181	*84.19*	28	*13.02*	5	*2.33*	1	*0.47*
Cough or snore loudly	0.18±0.51	186	*86.51*	19	*8.84*	9	*4.19*	1	*0.47*
Feel too cold	0.52±0.73	127	*59.07*	70	*32.56*	12	*5.58*	6	*2.79*
Feel too hot	0.95±0.83	73	*33.95*	86	*40.00*	48	*22.33*	8	*3.72*
Have bad dreams	0.46±0.72	138	*64.19*	61	*28.37*	10	*4.65*	6	*2.79*
Have pain	0.20±0.49	181	*84.19*	26	*12.09*	8	*3.72*	0	*0.00*

The correlation between variables based on the pretest data can be seen in Table 5. At pre-test, in males there was a significant correlation between overall sleep quality and quality of life (r=0.378), and overall sleep quality and the anthropometric measurements: weight (r=0.455), BMI (r=0.260), and waist circumference (r=0.234). A negative correlation was seen in males between sleep duration and weight (r=-0.193). In females, there was a correlation between overall sleep quality and quality of life (r=0.373).

Table 5: Correlation of Sleep Quality, Duration, and Anthropometrics[1]

	Sleep			Sleep Duration		
	Males	Females	Total	Males	Females	Total
Quality of Life[2]	**0.378**	**0.373**	**0.371**	*	*	*
Weight	**0.255**	*	**0.215**	**-0.193**	*	**-0.139**
BMI	**0.260**	*	**0.172**	*	*	*
Waist Circumference	**0.345**	*	**0.109**	*	*	*

[2]Measured by General Health Questionnaire (GHQ-12)(33).

*Not Significant.

All **Bold** values are significant at $p \leq 0.01$.

Questionnaire and Anthropometric Means±SD

In Table 6 are the measurements (mean±sd) for complete pre- and post- test data.

Table 6: Assessments for those with Complete Pre- Post- Test Data

	Males mean±sd	**Females** mean±sd	**Total** mean±sd
Pre-Test	n=72	n=80	n=152
General Health Questionnaire (α=0.87)[1]	9.64±3.99	10.25±4.73	9.95±4.38
Pittsburgh Sleep Quality Index (α=0.80)[2]	5.43±2.43	4.97±2.43	5.20±2.44
Body Mass Index	23.78±2.48	23.23±4.23	23.49±3.49
Waist Circumference (cm)	85.59±7.28	78.93±9.36	80.71±8.59
Post-Test			
General Health Questionnaire (α=0.87)[1]	11.20±4.87	11.56±4.52	11.38±4.66
Pittsburgh Sleep Quality Index (α=0.80)[2]	5.92±2.59	5.16±2.70	5.52±2.66
Body Mass Index	24.15±2.59	23.40±4.31	23.72±3.58
Waist Circumference (cm)	83.57±7.04	79.5±9.95	81.71±8.61

[1]Measures Quality of Life - Score range = 0 - 36; ≤12=good quality of life, 15 - 20=personal distress, >20=extreme psychological distress (33).

[2]Score Range= 0 - 21; ≤5= normal sleep quality, 6 - 21= disordered sleep (27).

Post-Test Results

No differences were seen for sleep quality or duration within or between gender or group (treatment n=72/control n=80) based on the one-way ANOVA. While no differences were seen between treatment/control groups an increase was seen within the treatment group quality of life scores from pre-test (9.88±3.23) to post-test (11.55±5.09) (p=0.006) (Table 7). The increase in quality of life score from pre- to post-test seen within the treatment group remained in the "good" quality of life range.

Table 7: Quality of Life[1] (mean±sd) by Group

	Pre-Test	Post-Test
Treatment	9.88±3.23	11.55±5.09[2]
Control	9.94±5.02	11.00±4.25

[1]Score range = 0 - 36; ≤12=good quality of life, 15-20=personal distress, >20=extreme psychological distress (33).

[2]Signifcant difference from pre- to post- based on one-way ANOVA (p =0.006) indicating a decreased quality of life (27).

Sleep and Anthropometrics

Sleep quality was related to anthropometric measurements for the total sample, and especially for males. As sleep quality becomes more disordered, post-test BMI increased (p=0.008). For every increase in sleep quality score, BMI increased by β=0.29 (CI=0.08-.5, p=0.008) (Table 8).

Table 8: Factors Affecting Body Mass Index for those with Complete Data

Post-Test BMI	df	β-Coefficient ±Standard Error	95% Confidence Interval		p-Value
			Low	High	
Sleep Quality	1	0.29±0.18	0.08	0.5	**0.008** [2]
Gender	1	0.94±0.50	-0.03	1.91	0.06
Group	1	- 0.26±0.50	-1.23	0.71	0.6
Age	1	0.28±0.23	-0.19	0.74	0.25
Quality of Life[3]	1	1.02±0.76	-0.48	2.52	0.18

[1]Total sample (n=152).

[2]For every unit Sleep Quality Scores increase (disorders increase) BMI increases by 0.29 unit (p=0.008).

[3]Quality of Life as determined by General Health Questionnaire-12 (Montazeri et al, 2003).

Waist circumference in males differed for normal and disordered sleepers by age. Disordered sleepers had higher post-test waist circumferences (88.7±8.9 cm) than normal sleepers (81.7±4.9 cm) (p=0.007) (Table 9). As age increased waist circumference also increased (p=0.031) by a factor of β=1.38.

Table 9: Factors Affecting Waist Circumference in Males[1]

Waist Circumference	df	F Value	p-Value
Sleep[2]	1	7.64	**0.007** [3]
Age	1	4.88	**0.031** [4]
Group	1	0.11	0.0744
Quality of Life[5]	1	0.07	0.0797

n=72.

[2]Sleep categorized by Normal (≤5) and Disordered (>5) on a scale from 0-21 (27).

[3]Disordered sleepers have higher waist circumferences (p =0.007).

[4]As age inceased waist circumference increased (p =0.031).

[5]Quality of Life categorized by Good (<15) and Poor (≥15) on a scale of 0-36 (33).

Sleep and Quality of Life

Sleep quality was disordered in 35% (n=43) of subjects (PSQI≤5) with complete data at pre-test. Among those subjects, 31% reported a poor quality of life at post-test (GHQ≥15, p=0.003). Disordered sleep quality was associated with approximately a 400% increased risk of poor quality of life at post-test (OR=4.11, 95% CI=1.6-10.4, p=0.003). For every increase in year of age there was a 57% increase in the risk for a poor quality of life (OR=1.57, 95% CI=1.01-2.46, p=0.045) (Table 10).

Quality of life decreased for subjects who got <7 hours of sleep per night (short sleepers) compared to those who slept the normal 7-9 hours per night (normal sleepers) (p=0.005). There was no effect on quality of life for subjects who slept >9 hours per night (long sleepers) when compared to the normal sleep duration (7-9 hours).

Table 10: Factors Affecting Quality of Life for the Total Sample[1]

Table 10: Factors Affecting Quality of Life for Total Sample[1]

Quality of Life[2]	df	Odds Ratio	95% Confidence Interval		*p* -Value
			Low	High	
Sleep Quality[3]	1	4.11	1.63	10.92	0.003 [4]
Sleep Duration					
<7 hours/night[5]	1	4.3	1.56	12.37	0.005 [6]
>9 hours/night[7]	1	1.85	0.37	7.37	0.423
Gender	1	1.295	0.5	3.41	0.59
Group	1	1.764	0.7	4.56	0.23
Age	1	1.571	1.01	2.46	0.045 [8]
Body Mass Index[9]	1	1.016	0.87	1.17	0.84

[1]n=144, missing data n=8.

[2]Quality of Life at Post-Test Based on GHQ-12 (33).

[3]Sleep based categorized by Normal (≤5) and Disordered (>5) on a scale from 0-21 (27).

[4]Disordered sleep quality was associated with approximately a 400% increased risk of poor quality of life at post-test (p =0.003).

[5]Duration compared to normal sleepers (7-9 hours).

[6]Sleepers with <7 hours per night had lower quality of life (p =0.005) .

[7]Duration compared to normal sleepers (7-9 hours).

[8]Increased age was associated with a 57% increased risk for lower quality of life.

[9]Body Mass Index at Pre-Test.

Correlations

The complete post-test correlations can be seen in Table 11. At the post-test for males there was a significant correlation between overall sleep and quality of life (r=0.459) and overall sleep quality and waist circumference (r=0.304). However, women had a significant correlation between BMI and quality of life (r=0.291). Regardless of test time there were significant correlations between sleep quality and quality of life, and sleep quality and anthropometric data.

Table 11: Post-Test Correlations

	Sleep			GHQ			Sleep Duration		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Quality of Life	**0.459**	**0.368**	**0.394**	*	*	*	*	*	*
Weight	*	*	**0.219**	*	*	*	**-0.193**	*	**-0.139**
BMI	*	*	**0.186**	*	**0.291**	**0.218**	*	*	*
Waist Circumference	**0.304**	*	**0.240**	*	*	*	*	*	*

[1]n=218.

[2]Measured by General Health Questionnaire (33).

*Not Significant.
All **Bold** values are significant at $p \leq 0.01$.

Chapter 5

DISCUSSION

The goal of this study was to assess sleep quality and quality of life in young adult college students (n=218), 18-24 years, who were part of an obesity prevention intervention focused on healthful eating and physical activity. Relationships between sleep and quality of life, anthropometrics and demographics were assessed at pre-test and at a 3-month post-test during fall, 2007. These subjects were predominately white, living on campus, and under the age of 21. Post-test data were collected from 152 subjects for a retention rate of almost 70%. While 69% of the sample had BMIs within the normal range, there were almost 9% who were in the obese range.

This researcher found a slightly lower percent (35%) of University of Maine students reporting disordered quality as compared to the 44% of first-year Taiwanese students who had disordered sleep quality based on the PSQI (16). While difficulty falling to or maintaining sleep was the most common sleep disturbance reported by the Taiwanese students, the UMaine students reported getting to sleep within 30 minutes and waking up in the early morning as the most common sleep disturbances. Both groups appeared to have trouble falling asleep or maintaining sleep. Additional research into the factors causing these disturbances could shed light on how to help college students overcome such sleep interferences.

It is interesting to find the relationship between sleep and anthropometric measurements in this group of college students, especially when Courtemanche (41), who studied the same group of young adults from which the current sample came, did

not find any relationship between fruit, vegetable and physical activity behavior and BMI. Based on the current findings, it appears that the relationship between sleep quality and BMI is linear, with BMI increasing as sleep quality decreases. When looking at sleep duration, Stamatakis and Brown (10) found that adults between the ages 20-92 who slept <7 hours and ≥9 hours had higher BMI's than subjects who slept within the normal range of 7-9 hours and they reported a "U" shaped curve for obesity risk factors. In the current study, this researcher found that as sleep duration decreased, weight went up for the total sample and for males, specifically.

The other anthropometric measurement that was related to disordered sleep was waist circumference which was higher for those with poorer quality of sleep than for those with normal sleep. Researchers (20, 42-43) have found waist circumference to be predictive of health risk, regardless of BMI. Higher waist circumference in 18-29 year olds was associated with decreased pulmonary function (20). Thus, there may be a relationship between disordered sleep and risk of chronic disease. Gangwisch and colleagues (11) found that too much or too little sleep were risk factors for increased rates of diabetes in middle aged adults. In the current study, young adults were screened out of the study from the beginning if they had chronic disease, such as diabetes. However, the increase in BMI and waist circumference seen with decreased sleep quality may allow for an increased predisposition for diabetes. Additional research should be performed to study the relationship between sleep and chronic disease in young adults.

Based on this researcher's review of literature, little is known about the relationship between sleep quality and quality of life. In fact, findings from this study (including results from the other researchers in the multistate team) appear to be the first for young adult college students. These findings that quality of life, as measured by the General Health Questionnaire-12, is impacted by sleep quality, duration, and age are important because of the potential impact on overall health. The differences seen in quality of life scores, while statistically significant, still fell within the "good" quality of life range. Of what practical significance are these findings? Could they be indicative of decreasing quality of life? Researchers have shown that even small increases in BMI during young adulthood indicate higher BMIs later in life (6,7). This researcher believes that quality of life may be no different. Early interventions during the college years could be designed to address the small decreases in quality of life and the impact mitigated.

While increased age was seen to be related to decrease quality of life there were three younger subjects who reported quality of life indicative of extreme psychological distress. These subjects were all 18 years old, first-year students, and living on campus. The transition to college can be a difficult time for some students, and the University of Maine residential life staff has recognized this possibility. There are programs in place to help first-year students have an easier transition to college life. This researcher expected to see younger students reporting a lower quality of life. Since this expectation was not the case statistically, the question "Why not?" comes to mind. It is possible that the programs meant to ease transition are having the desired effects.

Perhaps it is the stress of graduation and transitioning to life outside of school that affected the older students contributing to the lower quality of life among older students.

Chapter 6

CONCLUSION

The majority of these University of Maine young adults had a good quality of sleep (70%), normal sleep duration (74%) and a good quality of life (81%) based on the pre-test. However, when disordered sleep quality and short sleep duration were identified, there were associations with poor quality of life and anthropometric risk factors for obesity.

The mean sleep quality score was 5.36±2.70 at pre-test, just slightly above the cut-off for normal sleep quality, based on the Pittsburgh Sleep Quality Index (PSQI) (α=0.80). For those with complete data, 35% were identified as sleep disordered. The most frequent sleep disturbances were "cannot get to sleep within 30 minutes" and "wake up in the middle of the night or early morning".

An association between sleep and BMI was seen. As sleep quality became more disordered, BMI increased for the total sample and specifically for males. For every increase in sleep quality score, BMI increased by β=.029 (p=0.008). A relationship was seen between sleep and waist circumference for males. As sleep quality decreased in males, waist circumference increased.

Relationships between both sleep quality and sleep duration were seen with quality of life. When sleep quality decreased, quality of life also decreased. Disordered sleep quality was associated with approximately a 400% increase in risk of poor quality of life (p=0.003). When sleep duration was short (<7 hours), there was a decreased quality of life compared to normal sleepers (p=0.005).

Based on this study, demographics had little impact on sleep quality. However, there was an impact of age on quality of life. For every increase in year of age, there was a 57% increase in the risk for a poor quality of life (p=0.045)

This researcher, along with the other researchers in the multistate study, is among the first to investigate the impact of sleep on quality of life and anthropometrics in young adult college students. Based on the findings from this study, sleep should be addressed in wellness programming on university campuses, including its long-term implications on health. Exploring sleep and health implications in normal young adults is an emerging field with a plethora of opportunities for nutrition researchers.

REFERENCES

1. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999-2000. *JAMA*. 2002;288:1723-1727.

2. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, Marks JS. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*. 2008;289:76-79.

3. Lewis CE, Jacobs DR, McCreath H, et al. Weight gain continues in the 1990s: 10-year trends in weight and overweight from the CARDIA study. Coronary artery risk development in young adults. *Am J Epidmiol*. 2000;151:1172-1181.

4. Williamson DA, Lawson OJ, Brooks ER, Wozniak PJ, Ryan DH, Bray GA, Duchmann EG. Association of body mass with dietary restraint disinhibition. *Appetite*. 1995;25:31-41.

5. Klem ML, Viteri JE, Wing RR. Primary prevention of weight gain for women aged 25-34: the acceptability of treatment formats. *Int J Obes*. 2000;24:219-225.

6. McTigue KM, Garrett JM, Popkin BM. The natural history of the development of obesity in a cohort of young U.S. adults between 1982 and 1998. *Ann Intern Med*. 2002;136:857-864.

7. Guo SS, Huang C, Maynard LM, Demerath E, Towne B, Chumlea CW, Siervogel RM. Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: The Fels Longitudinal Study. *Int J Obes*. 2000;24:1628-1635.

8. Mego JL. The science behind obesity: some causes and solutions to the epidemic. *Am Fitness*. 2008;22:20-22.

9. Vasilakopoulou A, le Roux CW. Could a virus contribute to weight gain. *Int J Obes*. 2007;31:1350-1356.

10. Stamatakis KA, Brownson RC. Sleep duration and obesity-related risk factors in the rural Midwest. *Prev Med*. 2008;46:439-444.

11. Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Pickering TG, Rundle AG, Zammit GK, Malaspina D. Sleep duration as a risk factor for diabetes incidence in a large US sample. *Sleep*. 2007;30:1667-1673.

12. Amarantos E, Martinez A, Dwyer J. Nutrition and quality of life in older adults. *The Journals of Gerontology Series A*. 2001;56:54-64.

13. National Sleep Foundation. Adolescent sleep needs and patterns. Available at http://www.sleepfoundation.org. Accessed August 20, 2008.

14. National Institute of Neurological Disorders and Stroke. Brain basics: understanding sleep. Available at http://www.ninds.nig.gov. Accessed August 28, 2008.

15. Trockel MT, Barnes MD, Egget DL. Health-related variables and academic performace among first-year college students: implications for sleep and other behaviors. J *Am Coll Health*. 2000;49:125-131.

16. Yang CM, Wu CH, Hsieh MH, Liu MH, Lu FH. Coping with sleep disturbances among young adults: a survey of first-year college students in Taiwan. *Behav Med*. 2003;29:133-138.

17. Arnett JJ. Suffering, selfish, slackers? Myths and reality about emerging adults. *J Youth Adolsc*. 2007;36:23-29.

18. Arnett JJ. Emerging adulthood: a theory of development from the late teens through the twenties. *American Psychologist*. 2000;55:469-480.

19. Arnett JJ, Ramos KD, Jensen LA. Ideological views in emerging adulthood: balancing autonomy and community. *J Adult Develop*. 2001;8:69-79.

20. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA*. 2002;288:1728-1732.

21. Watkins JA, Christie C, Chally P. Relationship between body image and body mass index in college men. *J Am Coll Health*. 2008;57:95-99.

22. Brunt A, Rhee Y, Zhong L. Differences in dietary patterns among college students according to body mass index. *J Am Coll Health*. 2008;56:629-634.

23. Hendricks KM, Herbold N, Fung T. Diet and other lifestyle behaviors in young college women. *Nutrition Research*. 2004;24:981-991.

24. Bailey JA, Fleming CB, Henson JN, Catalano RF, Haggerty KP. Sexual risk behavior 6 months post-high school: association with college attendance, living with a parent, and prior risk behavior. *J Adolesc Health*. 2008;42:573-579.

25. Anderson DA, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: an initial evaluation. *Eating Behaviors*. 2003;4:363-367.

26. Betts NM, Amos RJ, Keim K, Peters P, Stewart B. Ways young adults view foods. *JNE*. 1997;29:73-79.

27. Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburg sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28:193-213.

28. Carpenter JS, Andrykowski MA. Psychometric evaluation of the pittsburg sleep quality index. *J Psychosom Res*. 1998;45:5-13.

29. Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test-retest reliability and validity of the Pittsburg sleep quality index in primary insomnia. *J Psychosom Res*. 2002;53:737-740.

30. Aloba OO, Adewuya AO, Ola BA, Mapayi BM. Validity of the pittsburg sleep quality index (PSQI) among Nigerian university students. *Sleep Medicine*. 2007;8:266-270.

31. American Psychiatric Association. Diagnostic and statistical manual of mental disorders, fourth ed. American Psychiatric Association, Washington (DC), 1994.

32. ASDA-American Sleep Disorders Association. International classification of sleep disorders, revised: diagnostic and coding manuals. American Sleep Disorders Association, Rochester, MN, 1997.

33. Montazeri A, Harirchi AM, Shariati M, Garmaroudi G, Ebadi M, Fateh A. The 12-item general health questionnaire (GHQ-12): translation and validation study of the Iranian version. *Health and Quality of Life Outcomes*. 2003;1:66-70.

34. Kaplan MS, Berthelot JM, Feeny D, McFarland BH, Khan S, Orpana H. The predictive validity of health-related quality of life measures: mortality in a longitudinal population-based study. *Quality of Life Research*. 2007;16:1539-1546.

35. Vanheule S, Bogaerts S. Short communication: the factorial structure of the GHQ-12. *Stress and Health*. 2005;21:217-222.

36. Zahran HS, Zack MM, Vernon-Smiley ME, Hertz MF. Health-related quality of life and behaviors risky to health among adults aged 18-24 years in secondary or higher education—United States, 2003-2005. *J Adolesc Health*. 2007;41:389-397.

37. Donath S. The validity of the 12-item general health questionnaire in Australia: a comparison between three scoring methods. *Australian and New Zealand Journal of Psychiatry*. 2003;35:231-235.

38. Toyabe SI, Shioiri T, Kobayashi K, Kuwabara H, Koizumi M, Endo T, Ito M, Honma H, Fukushima N, SOmeya T, Akazawa K. Factor structure of the general health questionnaire (GHQ-12) in subjects who had suffered from the 2004 Niigata-Cheutsu earthquake in Japan: a community-based study. *BMC Public Health*. 2007;5:175-181.

39. WebHealth Multi-State Research Team. Project WebHealth Study Manual. University of Maine, Orono. August 16, 2007. Revised September 17, 2008.

40. WebHealth Multi-State Research Team. Project WebHealth Study Manual. January 8, 2007. Revised September 15, 2008.

41. Courtemanche M. (2009) Assessment of change in fruit and vegetable intakes and exercise behavior of college students following an online intervention, unpublished thesis (M.S.), University of Maine.

42. Janssen I, Katzmarzyk R, Ross R. Body mass index, waist circumference, and health risk. *Arch Intern Med*. 2003;162:2074-2079.

43. Janssen I, Katzmaryzk P, Ross R. QWaist circumference and not body mass index explains obesity-related health risk. *AmJ Clin Nutr*. 2004;79:379-384.

Appendix A

General Health Questionnaire – 12

GHQ-12

Questionnaire 1 of 6

We would like to know if you have had any medical complaints and how your health has been in general over the past few weeks. Please answer the questions simply by selecting the answer that you think most nearly applies to you. Remember that we want to know about present and recent complaints not those you had in the past. Answering all the questions is important; however you always have the right to skip questions.

HAVE YOU RECENTLY:

1.-been able to concentrate on whatever you're doing?

- Better than usual
- Same as usual
- Less than usual
- Much less than usual

2.-lost much sleep over worry?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

3.-felt that you are playing a useful part in things?

- More so than usual
- Same as usual
- Less useful than usual
- Much less useful

4.-felt capable of making decisions about things?

- More so than usual
- Same as usual
- Less so than usual
- Much less capable

5-felt constantly under strain?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

6-felt you couldn't overcome your difficulties?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

7-been able to enjoy your normal day-to-day activities?

- More so than usual
- Same as usual
- Less so than usual
- Much less than usual

8-been able to face up to your problems?

- More so than usual
- Same as usual
- Less able than usual
- Much less able

9-been feeling unhappy and depressed?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

10-been losing confidence in yourself?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

11.-been thinking of yourself as a worthless person?

- Not at all
- No more than usual
- Rather more than usual
- Much more than usual

12.-been feeling reasonably happy, all things considered?

- More so than usual
- About the same as usual
- Less so than usual
- Much less than usual

Appendix B

Demographic Form

Questionnaire 6 of 6

This is the last questionnaire in the ProjectWebHealth Survey! Please answer these questions by selecting the response that is appropriate for you.

1. Which university do you attend?

2. Where do you live?

on-campus

off-campus

3. What is your year in school?

4. What is your major?

5. What is your race or ethnic group?

6. What is your height?

Feet:

Inches:

7. What is your weight (in pounds)?

8. How much do you want to weigh (in pounds)?

9. How fast is your rate of eating?

10. When you eat your main meal, about how long do you take?

11. Are you currently participating in a college sports team or club?

- Yes
- No

12. How many hours a week do you work in addition to class and homework?

- less than 1 hour
- 1 to 10 hours
- more than 10 hours

13. Please describe your credit load this semester...

- less than a full credit load
- a full credit load
- above a full credit load

14. Have you ever taken a college nutrition course?

- Yes
- No

Appendix C

Pittsburgh Sleep Quality Index

PSQI

Project WebHealth	DATE:	Subject initials:	Subject ID #:	State:

Pittsburgh Sleep Quality Index

Instructions: The following questions relate to your usual sleep habits during the *past month* only (except for #11). Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. Thanks.

During the past month,

1. When have you usually gone to bed? USUAL BED TIME _____
2. How long (in minutes) has it taken you to fall asleep each night? # OF MINUTES _____
3. When have you usually gotten up in the morning? USUAL GETTING UP TIME _____
4. How many hours of actual sleep do you usually get (This may be different than the number of hours you spend in bed)? HOURS OF SLEEP PER NIGHT _____

	not during the past month	less than once a week	once or twice a week	three or more times a week
5. During the past month, how often have you had trouble sleeping because you...				
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), *please describe*, including how often you have had trouble sleeping because of this reason(s):				

Complete other side

	not during the past month	less than once a week	once or twice a week	three or more times a week
6. During the past month, how often have you taken medicine (prescribed or over-the-counter) to help you sleep?				
7. During the past month, how often have you had trouble staying awake while in class, studying, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				

	Very good	Fairly good	Fairly bad	Very bad
9. During the past month, how would you rate your sleep quality overall?				

THANK YOU!!!

Appendix D

Informed Consent

Research Subject Information and Consent Form

Title of Study:	Project WebHealth: Behavior Change for Obesity Prevention in Young Adults
Study Investigator:	Adrienne A. White, Ph.D, RD
Staff	Mia Courtemanche—campus administrator (mia.courtemanche@umit.maine.edu) Jennifer Roy Jennifer.l.roy@umit.maine.edu Douglas Mathews Douglas.mathews@umit.maine.edu Mallory Poole Mallory.poole@umit.maine.edu

CAN I PARTICIPATE?
You must

- be 18-24 years old of age
- be a full-time student: freshman, sophomore or junior status
- have a body mass index $\geq$ 18.5
- be free from life threatening illness or other conditions such as pregnancy or diet and/or activity-related medical restrictions that would prevent participation in an online nutrition and fitness program and/or prevent accurate physical measurements.
- have access to a computer
- be able to participate in an online study

You must not be

- a current or former nutrition, exercise science and/or health promotion major
- enrolled in a nutrition course in Fall 2007

WHAT WILL I BE ASKED TO DO?

If you choose to participate, you will be asked to do the following assessments **3 times**. You must complete all of the August/September 2007 assessments to be enrolled in the study.

	Aug/Sept 2007	Nov/Dec 2007	Nov/Dec 2008
Complete online survey	X	X	X
Have weight and height measured	X	X	X
Have waist circumference measured	X	X	X
Do a step test	X	X	X

Online survey
The survey asks about fruit and vegetable intake, physical activity, and also asks questions such as "Sometimes things just taste so good that I keep on eating even when I am no longer hungry". It takes about 25 minutes to complete.

Physical Assessments: weight, height and waist circumference
You will need to make an appointment for these. Assessments will be done in a private room on campus and will take about 20 minutes. For these assessments, you will need to wear shorts and a t-shirt. Waist circumference is done by putting a measuring tape around your waist, at the top of your hip bones. The tape will need to be directly against your skin, not on top of a shirt. The tape will be snug, but will not compress your skin.

In order for these assessments to be accurate, you will need to avoid food, caffeine, alcohol and tobacco for at least 4 hours before your appointment.

Step test
The step test is a simple way to estimate physical fitness. To do this, a person steps up and down on a wooden box that is about as high as a tall bleacher step. The stepping goes on for 3 minutes to the beat of a metronome. You will have some time to practice before you are timed. After the 3 minutes are over, a staff member will measure your pulse. The step test occurs at the same appointment as weight/height/waist measurements.

In order for this assessment to be accurate, you need to avoid exercising the day of your appointment and the day before your appointment. Normal walking and activities are no problem, but you should avoid structured exercise or weight training for that period of time.

For the second and third set of assessments (at 3 months and 15 months from today) you will receive email reminder notices and directions to make an appointment.

Online Nutrition and Fitness Course
You will receive an email with details of your study participation after completing the first set of physical assessments. You may be asked to complete an online nutrition and fitness course. There are 10 modules (1 per week) designed to be completed in about 15 minutes. The educational sessions are designed to address eating and physical activity concerns of the individual. It is not a dieting program.

Additional Requests

Personal information will be requestied such as birth date, phone number, address, and social security number.

You may participate in an additional survey about sleeping habits each time you have a physical assessment done. There are 19 question swhich will take about 3-4 minutes to complete. Questions will be asked such as, "During the past month, how oftnen have you had trouble sleeping because you cannot get to sleep within 30 minutes or you wake up in the middle ofo the night or early morning?". You will be given the option to complete the survey immediately following the physical assessments within the privacy of the clinical lab. You do not have to complete this survey to be a part of the Project WebHealth Study.

WHAT DO I GET OUT OF IT?
You will receive $75.00 as money or as a gift card for completing all parts of the study according to the schedule below. Incentives will be distributed at or within one month after each measurement time point shown above. Study findings will be used to develop nutrition education materials for college students.

First appointment for assessments (Aug/Sept 2007)	$10
Second appointment (Nov/Dec 2007)	$25
Third appointment (Nov/Dec 2008)	$40

PLEASE NOTE: You are considered a participant in the study only after completing the first online survey (available today) AND the first set of assessments.

RISKS
Except for your time and inconvenience, the risk to participate is minimal. Your physical measurements will be taken in a private area to minimize any discomfort you may experience.

If you gain or lose weight which results in a 10% change in your body weight, you will be provided with information to contact University Health Services.

There is the risk to participants of an unintentional breach in confidentiality. This risk will be minimized by restricting access to the data to investigators and website managers directly associated with the study, by removing individual identifying information from the data once the data are collected, and by storing the data in secured databases and locked cabinets.

BENEFITS
Completion of the online course is expected to provide benefits that include such things as learning to incorporate healthful eating practices and physical activity. For the benefit of those who do not participate in the course, it will be available in the semester following the completion of the 15-month period. It is hoped that the online course will

be incorporated into a for-credit course for national dissemination and made available to many other college students.

VOLUNTARY

Your participation is voluntary. You may refuse to answer any questions that are part of the survey. You may decide not to participate or to discontinue participation at any time. If you leave the study for any reason, you will only be compensated for completed physical assessments. You are encouraged to contact your campus administrator should you decide not to continue your participation in this study.

CONFIDENTIALITY

The website is password protected for both the subjects and researchers. All information that you provide, either online or in person, will be kept confidential and your privacy will be protected to the maximum extent allowable by law. This statement means that the information can be released to a third party if subpoenaed by a court order.

The online survey you fill out will be stored in a database on the secured server maintained by Rainstorm Consulting in Orono, Maine. When data collection is complete, data will be removed from the server and transferred to disks and maintained at both the University of Maine and the University of Rhode Island (coordinating centers for entire project). Unidentifiable data will be shared with all researchers involved in the project. Your confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties.

When data are presented for scientific purposes, it will be reported in summary format, and no names will be used.

QUESTIONS

If you have any questions or concerns about what this study involves, please contact the researcher from your state (listed below). If you have concerns regarding your rights as a research participant, please contact the human subjects representative from your state (listed below)

Appendix E

Data Collection Form

PROJECT WEBHEALTH
DATA COLLECTION FORM

NAME: Last, First		**Gender** (circle) Male Female
BIRTHDATE (mo/day/yr):		**Year in School** (circle) Freshman Sophomore Junior
MAJOR:		**Are you willing to be contacted after the study is over to evaluate the program?** (circle) Yes No
CURRENT ADDRESS:		
HOME ADDRESS OR CONTACT INFORMATION IN CASE YOU MOVE:		
DAY PHONE # (with area code):	**CELL PHONE #** (with area code):	**EMAIL ADDRESS**:
BEST WAY TO CONTACT (check any applicable box): ☐ email ☐ day phone ☐ cell phone ☐ Other, specify:		
METHOD OF RECRUITMENT (explain how subject was recruited):		

NOTE: The following is for compensation purposes. Each state will determine whether SSN and/or subject signature required.

NAME: Last, First		SOCIAL SECURITY NUMBER	
	Baseline (Aug/Sept 2007)	3-month follow-up (Nov/Dec 2007)	15-month follow-up (Nov/Dec 2008)
Compensation given at time of assessment?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
Signature			
Date			

Subject ID #	**BASELINE**			**3-MONTH FOLLOW-UP**			**15-MONTH FOLLOW-UP**		
DATE									
TIME									
RESEARCHER who completed assessment									
EQUIPMENT (scale & stadiometer) used for assessment									
	Measure 1	Measure 2	Average of 1 & 2	Measure 1	Measure 2	Average of 1 & 2	Measure 1	Measure 2	Average of 1 & 2
WEIGHT (lbs)			*			*			*
HEIGHT (feet and inches)			*			*			*
WAIST CIRCUMFERENCE (cm)			*			*			*
BMI (record from calculated value on subject's edit page)									
Note: If BMI < 18.5 at baseline, subject is ineligible. Provide subjects with statement of referral to health center for low body mass index.									
% OF WEIGHT CHANGE[a]									
Note: If a 10% change in weight is determined at 3- or 15-months, provide subject with statement of referral for weight change.									
STEP TEST (pulse taken immediately after test)	15 seconds	15 seconds x 4=HR	Estimated VO_{2max}[b]	15 seconds	15 seconds x 4=HR	Estimated VO_{2max}[b]	15 seconds	15 seconds x 4=HR	Estimated VO_{2max}[b]
		*			*			*	
CONCERNS FOR ERROR (for weight, height, waist cicum., & VO2 max)									
COMMENTS							Has anything changed over the last year that might have affected your weight or body composition?		

* Enter these data on subject's edit page on the management website, www.projectwebhealth.com/manage

[a] % of weight change = (pre-weight -post-weight/pre-weight) x 100

[b] record calculated VO2 max from subject's edit page

If applicable: Date Subject becomes a drop-out _____.
Date Subject becomes inactive _____. Date Subject changes from inactive to active _____.
(Note: For subject activity, use date that CA clicks/un-clicks the inactive box on the subject's edit page on the study website.)

NAME: Last, First	
Year in School (circle) Freshman Sophomore Junior Senior	
CURRENT ADDRESS:	
PRIMARY PHONE # (with area code):	**EMAIL ADDRESS:**
BEST WAY TO CONTACT (check any applicable box): ☐ email ☐ primary phone ☐ Other, specify:	
Are you interested in being informed about participation in future studies? ☐ Yes ☐ No	
PERMANENT ADDRESS:	**PERMANENT PHONE NUMBER:**

completed at 15-month assessment, Oct-Dec 2008

BIOGRAPHY OF THE AUTHOR

Douglas Mathews was born in Rochester, NH on March 30, 1982. He graduated from Sanford High School in 2000. He received his Associate of Science in Culinary Arts in 2003, and an Associate of Science in Dietetic Technology in 2005. He received his Bachelor of Science degree in Food Science and Human Nutrition at the University of Maine in 2008. He is a proud member and advisor of the Senior Skull Society at the University of Maine. He is a candidate for the Master of Science degree in Food Science and Human Nutrition from The University of Maine in May 2010.