2012-12-11

Psychological Well-Being and Dietary Quality of College Women: Examining the Confounding Influence of Sleep and Physical Activity

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Psychological Well-Being and Dietary Quality of College Women: Examining the Confounding Influence of Season, Sleep and Physical Activity

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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December 2012

ABSTRACT

Psychological Well-Being and Dietary Quality of College Women: Examining the Confounding Influence of Season, Sleep, and Physical Activity

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Objective. To determine the relationship between overall psychological well-being and stress on diet quality among young adult women and to examine the potential confounding influence of season, physical activity and sleep on these relationships.

Design/Participants. The study used a cross-sectional design. Three hundred and fifty-one women were recruited to participate in the study. All participants were university students (20.2 ± 1.6 y). Overall psychological well-being was assessed using the General Well-being Schedule (GWB) and the Perceived Stress Scale (PSS). Diet intake was measured using three 24-hour recalls over a seven day period. The Healthy Eating Index (HEI) was calculated to assess diet quality. Physical activity (PA) and sleep were both measured objectively using accelerometers over seven consecutive days. Season of assessment was also included as a covariate.

Results. The average HEI score was 59.3 ± 12.5 out of 100 and is classified as "Needs Improvement." The average GWB score was 72.8 ± 13.1 out of 110 which is on the border between "moderate distress" (61 to 72) and "positive wellbeing" (73 to 110). Significant relationships were seen with specific aspects of psychological well-being, however global psychological well-being as measured by the General Well-being schedule was not related to any measure of diet quality. Chronic stress was related to low adherence to dietary guidelines ($F = 11.46$ and $p = 0.0008$). Chronic stress was also related to low consumption of fruits and vegetables ($F = 5.03$, $p = 0.0256$). Feeling in control of emotions and behaviors was related to low consumption of non-nutrient dense foods (NNDF) ($F = 3.33$, $p = 0.0198$). Controlling for PA and sleep time reduced the magnitude of all of these relationships between 11% and 42%. Results from the PSS were positively related to the consumption of NNDF ($F = 3.97$, $p = 0.0472$). Controlling for PA and sleep time increased the magnitude of this relationship by 34%. Season had a negligible impact on any of the relationships between psychological well-being and any measure of diet quality.

Conclusion. Subscales of psychological well-being such as chronic stress, acute stress, emotional behavioral control, and depression were related to diet quality. While these observed relationships were independent of the influence of season, physical activity and sleep, controlling for these variables had a moderating effect.

Keywords: dietary quality, non-nutrient dense food, college, HEI, women, psychological well-being, depression, stress, physical activity, sleep

ACKNOWLEDGEMENTS

I would like to thank my husband for all his support and encouragement during graduate school. I want to thank Dr. Bailey for all of the time and effort he put in to help me write this thesis and for his patience and encouragement throughout my experience as a graduate student. I would also like to thank Dr. LeCheminant and Dr. Lockhart for their help and support in writing this thesis and for the wonderful classes I had with them. My other partners and friends who worked on data collection with me were an enormous help as well: Matt Allen, Marshall Hill, and Wyatt Sessions.

I would like to thank my family for their support throughout my entire graduate work. My parents and in-laws have been exceptional in their support to help me complete the program. I want to thank the Savior for helping me to grow during this journey. I am grateful for the opportunity I had to study at Brigham Young University. I feel so appreciative to have been able to attend such a wonderful institution and work with and learn from such great people.

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Introduction

The prevalence of obesity in the US has risen dramatically over the last several decades [1]. This may be specifically true for young adults. According to the Behavioral Risk Factor Surveillance System, the greatest increase in the rate of obesity occurs among 18-29-year-olds who have some college education [2-3].

Extensive research has been committed to finding the reasons for this increasing prevalence of obesity. Dietary quality is one factor that may be partially responsible [4]. College students are susceptible to a diet of poor nutritional quality as they are surrounded by the conveniences of poor quality foods, as well as experiencing high levels of stress as college students. In addition, college students are experiencing independence and responsibility for making their own dietary decisions [5]. Such autonomy may lead to unhealthy dietary choices that are linked with weight gain and increased metabolic risk [5].

Food selection can be influenced by a number of factors. One such factor may be overall psychological well-being [4]. Overall psychological well-being is defined as one's subjective feelings of metal well-being and distress; how the individual feels about his/ her "inner personal state" [6]. This includes a persons' subjective perception of their energy level, satisfaction with the direction of their life, level of concern related to health, emotional and behavioral control as well as feelings of depression and anxiety.

Research into emotions has demonstrated that feelings of stress [7-8]; various moods [9-11] and depression [12-14] can alter diet behavior and food selection. In addition, food can become a source of worry, anxiety, and guilt [13-15]. This may put a person at greater risk for poorer dietary choices. Additionally, young women transitioning into adulthood may experience greater levels of psychological disturbance and distress [8]. College students are under large amounts of constant stress, and therefore may be more susceptible to stress affecting their eating behaviors [8]. College students experience a lifestyle change in their diet; as well as psychological changes such as moving away from home, building a new social network, and increased academic pressures [8]. These life changes can make college students inclined to change their eating behaviors and food choices [8]. Such changes may also alter physical activity and sleep patterns.

While it is clear that certain aspects of psychological well-being such as stress and depression influence food consumption and dietary behavior, the influence of overall psychological well-being is not as well understood. To date, no studies have examined overall psychological well-being and dietary quality among college women. Studies that have examined the relationship between emotions and diet quality have focused primarily on specific emotions [9-13]. The assessment of diet has also been limited, with assessment methods being low quality or ambiguous [7-13, 16-19]. In addition, potential confounding factors such as physical activity, sleep, and season have not been accounted for.

These weaknesses to the literature leave the relationship between overall psychological well-being, the subscales of psychological well-being and diet quality unclear. It is the intention of this study to overcome some of these weaknesses through the use of more accurate testing procedures including having subjects utilize: multiple-pass 24-hour recalls, the Perceived Stress Scale (PSS), and General Well-being Schedule (GWB). We will also objectively measure physical activity and sleep, which will be used as co-variates in data analysis. These methods of testing will help provide a clearer understanding of the role of overall psychological well-being and emotional subscales on dietary quality among college women. The primary purpose of this study is to determine the relationship between overall psychological well-being and stress on diet quality among young adult women and to examine the potential confounding influence of physical activity and sleep on these relationships.

Methods

Study Design

This study used a cross-sectional design to assess the relationship between overall psychological well-being and dietary quality of college women. Subscales of psychological well-being were also evaluated. The subscales of overall psychological well-being included stress, anxiety, depression, vitality, general health, positive well-being and self-control. Objectively measured physical activity, sleep, body mass index, season of assessment, and age were measured as co-variates.

Participants

College women were recruited through classroom visits, Facebook, emails, and word of mouth. In order to participate, women must have been between 18 and 26 years old and full-time undergraduate students. Women were excluded from the study if they smoked, were pregnant, took medications that altered their metabolism, or had restrictions on their physical activity such as having a heart condition, suffering chest pains during physical activity, feeling faint or severe dizziness, having high blood pressure, arthritis, or a bone or joint problem. Those interested in participating filled out a screening form to ensure the inclusion criteria were met. Demographic data was collected in a health history questionnaire. Three hundred and fifty-one women were included. Prior to participating, all women signed an informed consent form approved by the university's Institutional Review Board.

Procedures

Participants were asked to participate in two appointments separated by seven full days. Diet quality, overall psychological well-being, and subscales of psychological well-being were measured. Participation in the study involved completing three 24-hour recalls, the Perceived Stress Scale (PSS), and the General Well-being Schedule (GWB). During the first appointment height and weight were measured. Participants completed a 24-hour recall, the PSS, and the GWB. Participants were given a belt with the ActiGraph GT3X accelerometer (ActiGraph, Pensacola, FL) attached and instructed on how to properly wear the belt. A physical activity form was sent home with the participants on which they logged exercise activities performed, any times the belt was removed, the activities performed while the belt was off (e.g. swimming), and times when they went to sleep and woke up each day. Participants were instructed on how to do another 24-hour recall during the assessment week. This recall was a weekend day and was unscheduled so that the individual did not change their eating habits.

After 7 days the participants came back for their second appointment. Participants completed their third 24-hour recall. The accelerometer belt and activity and sleep log were turned in. The accelerometer data was downloaded and checked to make sure data was complete. If the participant forgot to wear the monitor or data was unusable (as the result of a monitor malfunction) the participants was given the monitor to wear again.

All data was assessed and checked for completeness. Each participant received a $15 cash incentive for participation.

Instrumentation and Measurement Methods

The following methods were used to assess body mass index, diet, overall psychological well-being, subscales of psychological well-being, season, sleep and physical activity.

Body Weight and Height

Body weight was measured on a digital scale (Tanita Corporation, Japan; modified by Life Measurenment, Inc., Concord, CA) to the nearest 0.005 kg. To standardize the assessment, participants were weighed while wearing a standard one-piece swimsuit. The scale was calibrated every two weeks. Height was measured using a wall-mounted stadiometer (Seca, Chino, CA) and recorded to the nearest 0.1 cm. Body mass index was calculated by dividing each participant's mass in kilograms by their height in meters squared.

Dietary Intake

Dietary intake was evaluated using multiple-pass 24-hour recalls. Participants completed three 24-hour recalls in a 7-day period. This included two weekdays (Monday through Friday) and one weekend day (Saturday only). This study used the ASA24 Automated Self-administered 24-hour Recall. This version produces individual-level nutrient estimates based on the Food and Nutrient Database for Dietary Surveys (FNDDS) and food group estimates based on USDA's MyPyramid Equivalents Database (MPED). This version of measuring dietary intake has methods of guiding the individual to remember everything they consumed. Web-based 24-hour recalls are shown to be valid and reliable and superior to that of the paper food frequency questionnaire [20]. It is assumed that participants truthfully reported their current state of psychological well-being, accurately reported all the food they ate in the 24-hour recalls, and that three diet recalls accurately reflect habitual food consumption.

Dietary Quality

To evaluate and score dietary quality, the Healthy Eating Index (HEI) was used. The HEI was developed by the United States Department of Agriculture (USDA) to score diets based on suggested consumption amounts in conjunction with the 2005 dietary guidelines [21].

According to the USDA (2012) the recommendations have not changed from 2005 to 2010 [22]. HEI was calculated from the results of the 24 hour recalls. The HEI components were updated to match the MyPyramid equivalents in 2005; there are 12 HEI components to the HEI-2005 (total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium, and calories from solid fats, alcoholic beverages and added sugars) (see Table 1) [22]. Each component of the HEI was scored individually with each item being scored as a percentage of the maximum score based on the amount of food habitually consumed [22].Each score from the 12 components was combined for a total HEI score to measure diet quality [22].

- Diet quality was classified as "Good" if the HEI score ≥ 80
- Diet quality was classified as "Needs Improvement" if the HEI score was 51-80
- Diet quality was classified as "Poor" if the HEI score was <51

This index has been used in other studies to evaluate adherence to MyPyramid recommendations [23-25]. In addition the HEI has been validated against nutritional biomarkers [26].

Non-Nutrient-Dense Foods (NNDF), or 'Junk Food,' was calculated as a percentage of total calories. As defined by Hopping et al. (2010) NNDF includes: hash browns/potato patties/French fries, gravy, salad dressing, mayonnaise, dips, pizza, ice cream, cakes/muffins, pies, cheesecake, chocolate bars, crisps, crackers, sweet biscuits, sweets, popcorn, granola bars, sweetened drinks, carbonated beverages (regular, not diet), butter/margarine, jam/marmalade, and sugar/honey [27].

Psychological Well-being

Psychological well-being was assessed using the General Well-being Schedule (GWB) and the Perceived Stress Scale.

General Well-being Schedule (GWB)

Overall psychological well-being was assessed with the self-reported, 18-item GWB [28]. The GWB was developed by the National Center for Health Statistics and was administered as part of the National Health and Nutrition Examination Survey. The GWB was named to be the "single most useful instrument in measuring depression" after being investigated by 28 psychological well-being and depression scales [28]. Therefore, the GWB was used as the measurement tool for psychological well-being in this study. This instrument measures multiple factors of psychological well-being including health worry, energy level, satisfying-interesting life, depressed-cheerful mood, emotional-behavioral control, and relaxed vs. tense-anxious [28].

The General Well-being Schedule is a self-administered questionnaire that focuses on one's subjective feelings of psychological well-being and distress [6]. The scale assesses how the individual feels about his/ her "inner personal state" [6]. It consists of 18 items covering six dimensions of anxiety, depression, general health, positive well-being, self-control and vitality [6]. The scale includes both positive and negative questions and each item has the time frame "during the last month" [6]. The first 14 questions use six-point response scales representing intensity or frequency [6]. The remaining four questions use 0-to-10 rating scales defined by adjectives at each end [6]. There is a total score running from 0 to 110 with lower scores indicating more severe distress [6]. The three levels of distress are sectioned accordingly: 0 to 60 reflect "severe distress"; 61 to 72 "moderate distress"; and 73 to 110 "positive wellbeing" [6]. Scores can be narrowed further into severe, serious, distress, stress problem, marginal, low positive and positive well-being [6]. It took approximately 10 minutes to administer the questionnaire [6].

The GWB has been assessed as valid and reliable [29]. The average correlation of the GWB Schedule and six independent depression scales was 0.69 [29]. Correlations between individual subscales and criterion ratings were high, ranging between 0.65 and 0.90 [29]. The test-retest reliability coefficients (after three months) of 0.68 and 0.85 for two different groups [29]. Internal consistency coefficients for the three subscales range from 0.72 to 0.88 [29]. Three studies reported internal consistency coefficients over 0.9 [29].

Stress

Perception of stress was measured two ways to get a view of acute stress (1 month) vs. chronic stress (1 year).

Acute stress was assessed using the Perceived Stress Scale (PSS). The Perceived Stress Scale assesses how different situations influence feelings and perceived levels of stress [30]. The questions in the scale ask about an individual's feelings over the past week [30]. This scale considers the person's perceptions of what is happening in their life are most important [30]. It is a valid measurement for assessing stress [31-33]. PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items [30].

- Perceived stress was classified as "Very low" if the PSS score was 0-7
- Perceived stress was classified as "Low" if the PSS score was 8-11
- Perceived stress was classified as "Average" if the PSS score was 12-15
- Perceived stress was classified as "High" if the PSS score was 16-20
- Perceived stress was classified as "Very high" if the PSS score was 21 and over

Chronic stress was assessed using a single-item measure of psychosocial stress. This question asks "In the past year, how would you rate the amount of stress in your life?" This single item question was assessed on a scale from 1-6. The single-item question has been shown to be reliable with validity similar to longer questionnaires [34].

Season

Season was assessed by the following classifications:

- Fall: September, October, and November
- Winter: December, January, and February
- Spring: March, April, and May
- Summer: June, July, and August

Physical Activity

Physical activity was assessed by using the ActiGraph GT3X+accelerometer. Accelerometers were used because they show good correlations (r = 0.74 to 0.95) to total activity levels from walking, running, and other activities [35-39]. The accelerometer was worn on the right side of the body at the level of the umbilicus and above the anterior superior iliac spine. Participants wore the belt continually for seven consecutive days, removing it for water activities only (showering and swimming). Participants were asked to log any time the belt has to be removed for water activities or if they forgot to wear it for any amount of time.

A day's data was considered complete if the participant wore the monitor 75% of the time between 7 a.m. to 11 p.m. Non-wear time was conservatively defined as twenty or more minutes of consecutive zeros [40]. Data was collected in 60-second epochs. Physical activity intensity levels were categorized using the cut-points established by Troiano et al. (2008):

vigorous activity (>5999 counts/min), moderate activity (2020-5999 counts/min), light activity (250-2019 counts/min), and sedentary (0-249 counts/min) [41].

Sleep

Sleep was assessed by actigraphy using the ActiGraph GT3X Activity Monitor (ActiGraph, Pensacola, FL). The same accelerometer used to measure physical activity was used to measure sleep. For seven consecutive nights, participants were asked to wear the activity monitor at waist level. Participants were instructed to wear the monitor at all times every night. Participants were also given a sleep log to record their bed times and wake up times for each day. Studies have shown that activity monitors produce similar sleep measurements as polysomnography, the accepted gold standard of sleep analysis [42-43].

Data from the accelerometer was downloaded in 60-second epoch lengths. Files were then manually searched to determine the specific moment of the onset and ending of sleep. Bed time was said to occur after the participant had taken no steps and had registered no activity velocity for a period of five minutes. Wake up time was said to occur when the participant registered over five steps per minute and there was registered activity velocity for a period of five minutes. This activity needed to continue in regular patterns for wake up time to be verified. Each participant recorded two weekend nights and at least 4 week day nights. Sleeping amount was categorized using sleeping durations established by Stamatakis and Brownson (2008): less than 7 hours; 7-8 hours; and greater than or equal to 9 hours [45].

Data Analysis

In the study, the criterion variables were diet quality (HEI), junk food and fruits and vegetables. The predictor variables included overall psychological well-being, and subscales of psychological well-being. The three levels of distress are sectioned accordingly: 0 to 60 reflect “severe distress”; 61 to 72 “moderate distress”; and 73 to 110 “positive wellbeing” [6]. Means and standard deviations were calculated and reported for all predictor and criterion variables. The general linear model was used to assess relationships between criterion and predictor variables. The influence of potential confounding variables on primary relationships was determined using partial correlations. Control variables included physical activity, sleep, BMI, season of assessment, and age. Distributed bivariate relationships were determined using Pearson correlations. The total HEI score was used to rank individuals by overall dietary quality and individual component scores of HEI was used to determine adequacy or inadequacy of dietary intake of specific food groups and nutrients, such as servings of dairy, fruits, or vegetables. In addition, dietary quality was classified using the recommended HEI criteria as “Good” (≥ 80), “Needs Improvement” (51-80), and “Poor” (<51) [22]. The general linear model was also used to evaluate differences in overall psychological well-being and specific aspects of psychological well-being between participants being classified as “Good,” “Needs Improvement,” or “Poor” diet quality. Stepwise regression was used to determine the best model for predicting diet quality. All analyses were performed using PC-SAS (version 9.3) and alpha was set at $p < 0.05$.

Results

A total of 351 women were recruited to participate in the study. Of those 351 women, 347 women had complete data for dietary quality, the General Well-being Schedule, and the Perceived Stress Scale. All women included in the analysis had three complete 24-hour recalls, a completed GWB Schedule and a completed PSS.

The characteristics of the 347 women are reported in Table 1. Participants were primarily Caucasian (88.2%), with the remaining women including Asian, Hispanic, African-American, and other. The participants in the study represented 36 different states and 6 different countries. Participants were on average 20.2 ± 1.6 years, normal weight (BMI: 22.6 ± 2.9 kg/m^2) and slept 7.1 hours ± 44.6 minutes a night. In addition, the women were relatively active, accumulating 398,555 ± 133,946 counts per day (accelerometer counts).

Diet quality for participants was evaluated using the HEI-2005 (see Table 1). The average HEI score was 59.3 ± 12.5 out of 100. The mean HEI score is classified as "Needs Improvement." Of the women in the study, 27% had diets classified as "Poor," 68% had diets classified as "Needs Improvement," and 5% had diets classified as "Good." Only 27% of women met the requirement for milk products; 31% of women met their fruit guidelines; 15% met recommendation for vegetables; 95% of women consumed high amounts of solid fats and added sugars.

Psychological well-being was measured using the General Well-being Schedule and the Perceived Stress Scale. The GWB subjectively measures feelings of psychological well-being and distress [6]. The average score was 72.8 ± 13.1 out of 110 which is on the border between "moderate distress" (61 to 72) and "positive well-being" (73 to 110) [6]. Of the women in the study 10.6% had psychological well-being classified as "severe distress," 30.0% had psychological well-being classified as "moderate distress," and 59.4% had psychological well-being classified as "positive wellbeing." The PSS assesses how different situations influence feelings and perceived levels of stress [30]. The average score was 15.0 ± 6.0 out of 35 which is classified as "average" [30].

Significant relationships were seen with specific aspects of psychological well-being, however global psychological well-being as measured by the General Well-being schedule was not related to any measure of diet quality (F = 0.11, F = 0.7459). Stress was one aspect of psychological well-being that was related to diet quality. The amount of stress perceived to experience over the previous year (chronic) was inversely related to the HEI-2005 (See Table 4). Women that experienced high stresses (scoring a 5 or 6 out of 6) had lower scores in diet quality compared to women who experienced lower levels of stress. Controlling for age and season had a statistically negligible impact on this relationship, however, controlling for PA levels and total sleep time reduced the magnitude of the relationship by 34% and 30% respectively. Similarly, controlling for age, season, PA and sleep at the same time reduced the magnitude of the relationship 42%.

Perceived stress over one year (chronic) was also inversely related to the consumption of fruits and vegetables (F = 5.03, p = 0.0256). After controlling for age, this relationship to consuming fruits and vegetables was strengthened by 35.6%. Controlling for PA levels reduced the magnitude of the relationship 30.4%. Controlling for sleep time reduced the magnitude of the relationship 15.2%. Season has a negligible influence on this relationship. And when controlling for age, season, PA and sleep reduced the magnitude of the relationship 12.7%.

Emotional behavioral control was inversely related to the consumption of NNDF (See Table 5). Controlling for age and season has a negligible impact on this relationship, while controlling for PA levels reduced the magnitude of the relationship 13.4% and controlling for sleep time reduced the magnitude of the relationship by 35.5%. Controlling for age, PA, and sleep at the same time reduced the magnitude of the relationship 34.3%.

Results from the perceived stress scale for acute stress over the past month were positively related to the consumption of NNDF (See Table 6). After controlling for age and season the relationship to consuming NNDF was strengthened 19.8% and 26.1%, respectfully. Controlling for PA levels increased the magnitude of the relationship 7.3%. Controlling for average amount of sleep increased the magnitude of the relationship 16.7%. And when controlling for age, season, PA, and sleep at the same time the magnitude of the relationship increased the magnitude of the relationship 68.4%.

Stepwise regression demonstrated that the best model for predicting HEI-2005 included health worry (F = 4.77, $p = 0.0298$), perceived chronic stress over the previous year (F = 4.34, $p = 0.0380$), physical activity (F = 6.95, $p = 0.0088$), age (F = 4.46, $p = 0.0354$), and BMI (F = 8.77, $p = 0.0033$). Health worry, perceived chronic stress over the previous year, and BMI were all negatively correlated with HEI-2005 score. Physical activity and age were positively correlated with HEI-2005 score. Similarly, the best model for predicting fruit and vegetable consumption included perceived chronic stress over the previous year (F = 4.79, $p = 0.0294$), physical activity (F = 12.45, $p = 0.0005$), and age (F = 17.91, $p = 0.0001$),. Physical activity and age were positively correlated to fruit and vegetable consumption while perceived chronic stress over the previous year was negatively correlated with fruit and vegetable consumption. The best model for predicting NNDF included emotional behavioral control (F = 4.84, $p = 0.0284$), cheerful vs. depressed mood (F = 4.49, $p = 0.0348$) and total perceived stress (F = 2.83, $p = 0.0933$), of which emotional behavioral control was inversely correlated to NNDF, and cheerful vs. depressed mood and perceived stress (PSS) were both positively correlated to NNDF.

Discussion

In the U.S. dietary quality has been classified as “Needs Improvement” when evaluated using HEI-2005 [46]. Based on NHANES (2003-2004) data, the average HEI-2005 score was 57.2 out of 100 [46]. The HEI-2005 for women was slightly higher than men (60.3 vs. 54.8) and seems to get better with age as the HEI-2005 for those between the ages of 20-39 years was 54.2, those between 40-59 years was 57.0, and those 60 years and over was 63.8 [46]. Additionally, the HEI-2005 for individuals with a high school diploma or GED was 53.0, while the HEI-2005 for individuals with more than a high school degree was 59.5 [46]. Although the average HEI-2005 for our study (59.3) was higher than the average young adult, our sample consisted of all college women. Thus, results from our study demonstrate good agreement to those seen using NHANES (2003-2004) data [46].

Because only 5% of the women in the study had diets classified as “Good”, there are aspects of the diet that were lacking. For example, only 27% met the requirement for milk products; 31% met their fruit guidelines; and only 15% met the recommendation for vegetables. Furthermore, 95% of women consumed high amounts of saturated fats, sodium, and calories from solid fats and added sugars.

The primary purpose of this study was to evaluate the extent to which overall psychological well-being and stress are related to diet quality among young adult women. Significant relationships were seen with specific aspects of psychological well-being, however global psychological well-being as measured by the General Well-being schedule was not related to HEI-2005, fruit and vegetable consumption, or junk food consumption. The reason that there was no relationship between overall psychological well-being and HEI-2005 is likely because not all psychological distress has the same impact on dietary choice. However, our study found relationships between chronic and acute stress and diet quality, emotional behavioral control and diet quality, and depression and diet quality.

We found that the amount of perceived stress experienced over the previous year (chronic stress) was related to low fruit and vegetable consumption and to poor adherence to dietary guidelines. Women that experienced high stress had lower scores in diet quality compared to women who experienced lower levels of stress. Some research supports that greater stress has been associated with more fatty food intake and less fruit and vegetable consumption [16]. Likewise, women with the highest level of psychological and emotional distress scored high in emotional eating and demonstrated the lowest intake of fruits and vegetables [4].

In contrast to stress over one year, the perceived stress scale (PSS) focuses on more acute stress over the previous month. A perception of high levels of acute stress was related to greater consumption of NNDF. A number of researchers have shown that when individuals are stressed they often turn to junk foods that are high in calories and low in nutrients [49-55]. For example, Hudd et al. (2000) found that 78.2% (n = 61) of a group that was "stressed" had consumed junk food, whereas 61.9% (n = 39) of the lower stress group had done so [55]. This increase in NNDF is not surprising since other studies have shown that stress has the potential to increase food motivation to provide energy for the stress response as well as provide a stimulus to bring the body back to homeostasis [56].

While our study generally supports other research that has been performed evaluating stress and food consumption, there are a number of interesting additions to the current literature. First, chronic stress over one year was more related to lower adherence to dietary guidelines and lower fruit and vegetable consumption, while more acute stress over the previous month was related to greater NNDF consumption. The reason for these relationships is not completely clear, however it is possible that chronic stress alters habitual dietary choice, while more acute stress drives food seeking behavior in a way to meet a the current energy demands and works to attenuate the stress response [56].

In addition, while the relationships between stress and diet quality was independent of physical activity and sleep, these two variables played a meaningful role in altering the relationship. For example, both physical activity and sleep strengthened the relationship between acute stress and NNDF but weakened the relationship between chronic stress and adherence to dietary guidelines and fruit and vegetable consumption. Both PA and sleep may be able to buffer stress [57-58]. These behaviors may also cluster together with diet quality as healthy behaviors making it difficult to determine how the behaviors relate to stress individually. Regardless, stress (acute or chronic) tends to result in poorer diet quality and this relationship is independent of both PA and sleep.

Emotional behavioral control is defined as feeling emotionally stable and in firm control of behaviors and emotions [28]. One interesting finding was that emotional behavioral control was also inversely related to the consumption of NNDF. It is postulated that emotional distress may impair a person's motivation or ability to exert self-control and they indulge immediate impulses to make themselves feel better [59]. Some research has suggested that many women manage their emotional distress through eating calorically dense foods [4, 60]. While our study supports this, PA and sleep time weakened this relationship. Accounting for both made the relationship borderline significant. Therefore, PA and sufficient amounts of sleep may help women manage and control their emotions and behaviors, leading to less consumption of non-nutrient dense foods (junk food).

Another finding for our study is that cheerful vs. depressed mood is positively correlated to the consumption of non-nutrient dense foods when other factors such as emotional behavior control and perceived stress were accounted for. It has been reported in the literature that depression may lead to eating poor quality/low-nutrient foods and that depressed individuals reported increasing their consumption of carbohydrate- and fat-rich snacks as they become depressed [61-62]. Some research has suggested that greater adherence to dietary guidelines were associated with reduced symptoms of depression [63] and that lower adherence to dietary guidelines score had higher depression scores [64]. Our study does not support this relationship between the adherence to dietary guidelines and depression. The reason our findings do not agree with previous research may be a result of differences in the populations. In one study subjects included 1,118 African-American and white adults, aged 30 to 64 years, living in Baltimore, MD, and represented a subsample of the initial examination and recruitment phase of the Healthy Aging in Neighborhoods of Diversity across the Life Span study [63]. In the other study subjects were Cuban-Americans with and without T2D living in South Florida [64]. Our study included all young adult women and was primarily Caucasian.

There are a few limitations to our study. A principle limitation of this study is its cross-sectional design, which does not allow the direction of the relationship between overall psychological well-being and diet quality to be determined and cause and effect should not be inferred. Also, the dietary 24-hour recall requires the participant to accurately report all the food they consumed from memory and the data is reliant on self-report. While this results in some potential for error the strength of the 24-hour recall is that it is non-reactive and measures actual food consumption. Finally, participants were all living in a limited geographical area. However, these participants were taken from two universities and represented 36 different states and 6 different countries.

While there are some limitations to our research, the findings from this study make some significant contributions to the existing literature on psychological well-being and its impact on diet quality. To date, no studies have examined overall psychological well-being and dietary quality among college women. Likewise, the assessment of diet quality has also been limited, with assessment methods being low quality or ambiguous [7-13, 16-19]. In addition, potential confounding factors such as physical activity and sleep have not been accounted for and clearly have an impact on many relationships between psychological well-being and diet quality.

Conclusion

Findings from our study demonstrate that overall psychological well-being is not related to diet but certain aspects of psychological well-being and stress are related to food choice and subsequent diet quality. Chronic stress tends to reduce adherence to dietary guidelines, while acute stress is more related to NNDF consumption. Feeling of having less control over emotions and behaviors and depression are also related to NNDF consumption. The relationships seem to be moderated by both physical activity and sleep. While it is possible that health behaviors cluster together and explain part of this finding, it is also possible that sleep and physical activity help a person manage stress and increase emotional control, which may improve a person's ability to make better food choices. Future research should evaluate these relationships longitudinally, in male and female populations of a greater age range.

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Table 1. Healthy Eating Index-2005 Components and Standards for Scoring[1]

Component	Maximum Score	Standard for Maximum Score	Standard for Minimum Score of Zero
Total Fruit (includes 100% juice)	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit (not juice)	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Dark Green and Orange Vegetables and Legumes[2]	5	≥0.4 cup equiv. per 1,000 kcal	No Dark Green or Orange Vegetables or Legumes
Total Grains	5	≥3.0 cup equiv. per 1,000 kcal	No Grains
Whole Grains	5	≥1.5 cup equiv. per 1,000 kcal	No Whole Grains
Milk[3]	10	≥1.3 cup equiv. per 1,000 kcal	No Milk
Meat and Beans	10	≥2.5 cup equiv. per 1,000 kcal	No Meat or Beans
Oil[4]	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat	10	≤7% of energy[5]	≥15% of energy
Sodium	10	≤0.7 gram per 1,000 kcal[5]	≥2.0 grams per 1,000 kcal
Calories from Solid Fat[6], Alcohol, and Added Sugar (SoFAAS)	20	≤20% of energy	≥50% of energy

[1] Intakes between the minimum and maximum levels are scored proportionately, except for Saturated Fat and Sodium (see note 5).

[2] Legumes counted as vegetables only after Meat and Beans standard is met.

[3] Includes all milk products, such as fluid milk, yogurt, and cheese.

[4] Includes non-hydrogenated vegetable oils and oils in fish, nuts, and seeds.

[5] Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 grams of sodium/1,000 kcal, respectively.

[6] Solid fats include both saturated fats and trans fats. Solid fats include butter, milk fat, beef fat, chicken fat, cream, pork fat, stick margarine, shortening, hydrogenated and partially hydrogenated oils, coconut oil, palm and palm kernel oils.

Source: Taken from USDA. Healthy Eating Index--2005. (PDF)

Table 2. Demographic Data

Variable	M	SD	Range
Age (yrs)	20.23	1.59	17.70-26.08
Height (cm)	165.85	6.71	147.20-183.60
Weight (kg)	62.17	9.12	45.17-95.57
BMI (kg m^{-2})	22.58	2.88	17.13-34.80
Physical Activity (counts)[a]	398.55	133.95	38.14-1043.62
Sleep Time (min)	428.11	44.56	282.50-537.50
HEI-2005 Score	59.31	12.49	27.19-88.95
Calories (Kcal)	1980.62	540.59	659.31-4747.20
Non-nutrient Dense Food (%)	27.39	11.89	0.0-73.86
General Well Being Score	72.80	13.10	29.00-98.00
Perceived Stress Score	15.00	5.98	3.00-35.00

[a]Physcial activity level was divided by 1000

Table 3. HEI-2005 Total and Component Scores

			HEI Score		Maximum
Label	M	SD	M	SD	HEI Score
Total HEI-2005 Score			59.3	12.5	100
Total Fruit (eqv)	0.69	0.53	3.3	1.7	5
Whole Fruit (eqv)	0.55	0.52	3.6	1.8	5
Total Vegetables (eqv)	0.65	0.42	2.7	1.4	5
Dark Green & Orange Vegetables & Legumes (eqv)	0.15	0.19	1.7	1.7	5
Total Grains (eqv)	3.76	0.99	4.8	0.5	5
Whole Grains (eqv)	0.73	0.61	2.2	1.5	5
Milk (eqv)	1.05	0.55	7.2	2.7	10
Meat & Beans (eqv)	2.11	1.07	7.5	2.5	10
Oils (eqv)	8.38	4.64	6.5	2.8	10
Saturated Fat (eqv)	11.97	3.24	4.9	3.4	10
Sodium (mg)	1637.2	341.7	3.6	2.3	10
Calories from Solid Fat, Alcohol & Added Sugars (%)	32.7	7.7	11.4	4.8	20

HEI = Healthy Eating Index

M = mean, SD = Standard Deviation

eqv = Equivalents per 1000 kcal

Table 4. The Difference Between HEI-2005 Score and Stress (Chronic) Over the Previous Year Rated as High or Moderate/Low with Statistical Adjustments for Age, Physical Activity and Sleep

Control Variable	Group 1 N = 197		Group 2 N = 154		F	P
	M	SD	M	SD		
None	61.3	12.1	56.8	12.5	11.46	0.0008
Age	61.1		56.7		11.09	0.0010
Season	60.6		56.22		11.10	0.0010
Physical Activity	60.8		57.1		7.58	0.0062
Sleep Time	60.5		56.6		7.89	0.0053
All Variables	60.0		56.4		6.47	0.0115

M, mean

SD, standard deviation

$P < 0.05$, indicates a significant mean difference

Group 1, include women who ranked their stress as 1 - 4 on a scale of 6

Group 2, include women who ranked their stress as 5 - 6 on a scale of 6

Table 5. The Difference between Non-nutrient Dense Food Consumption for Women Scoring Progressively Higher in Emotional Behavioral Control (EBC) with Statistical Adjustments for Age, Physical Activity, and Sleep

Control Variable	Group 1 N = 48		Group 2 N = 96		Group 3 N =171		Group 4 N=36		F	P
	M	SD	M	SD	M	SD	M	SD		
None	30.9[a]	11.7	26.8	10.9	27.7	11.9	22.8[b]	13.3	3.33	0.0198
Age	30.7[a]		26.8		27.7		22.9[b]		3.03	0.0294
Season	31.4[a]		27.2		28.2		23.3[b]		3.37	0.0188
Physical Activity	30.8[a]		27.0		27.9		22.9[b]		3.04	0.0290
Sleep Time	30.7		26.7		28.0		23.3		2.43	0.0654
All Variables	30.6		26.9		27.9		23.3		2.44	0.0645

[a,b] Indicates a significant mean difference ($P < 0.05$).

M, mean

SD, standard deviation

Group 1, scored 6, 7, 8 for EBC scale

Group 2, scored 11, 10, & 9 for EBC scale

Group 3, scored 12 & 13 for EBC scale

Group 4, scored 14 & 15 for EBC scale

Table 6. Linear Relationship Between Perceived Stress Over the Previous Month (Acute) and Percent Calories from Non-Nutrient Dense Foods After Adjusting for Specific Covariates (n=347)

Perceived Stress	b	F	P
Variable Controlled:			
None	0.21	3.97	0.0472
Age	0.23	4.83	0.0286
Season	0.24	5.02	0.0256
Physical Activity (counts)	0.20	3.64	0.0574
Sleep Time	0.24	4.52	0.0342
Full Model[a]	0.29	6.63	0.0105

b = regression coefficient. Values in the column showing regression coefficients reflect changes in perceived stress that correspond to a change in the percentage of NNDF consumed.

[a] Full Model includes statistical adjustment for differences in age, physical activity, and sleep time.