The Relationship Between Sleep and Night Eating on Weight Loss in Individuals with Severe Mental Illness

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Abstract

Introduction: Insomnia and night eating is associated with weight gain in individuals with Severe Mental Illness (Palmese, et al., 2011). Poor sleep, night eating, and psychiatric medications may hinder weight loss which, in turn, can sustain obesity in individuals with psychiatric disabilities.

Purpose: The study examined the relationship of sleep and avoidance of night eating on weight loss in individuals who participated in the Psychiatric Rehabilitation Program for Weight Loss.

Question: Will self-report of the frequency of getting enough sleep and avoidance of night eating predict weight loss?

Design: This secondary analysis focuses on data from participants in a weight loss intervention group (N=34) after 3 month of intervention.

Methodology: Sleep and night eating scores from the Pender Health-Promoting Lifestyle Profile-II and total score of the Night Eating Questionnaire, respectively, served as predictor variables. Changes in body weight from baseline to 3 months was the criterion variable.

Findings: No significant correlation (.354, p=0.24) was found between the Night Eating Questionnaire score and weight loss while report of sleep and weight loss were correlated (-3.44, p=0.05). Because scores on participants' perception of getting enough sleep and total score for the Night Eating Questionnaire were intercorrelated (-.507, p=0.09) and because only scores from 12 participants on the Night Eating Questionnaire were available, a bivariate regression was performed on weight loss and frequency of getting enough sleep. The frequency of getting enough sleep that accounted for weight loss was low (R^2= .119).

Discussion: Self- report of getting enough sleep is a poor predictor of weight loss. Future studies examining weight loss in this population should use a more robust measure of sleep, and an increased sample size

Introduction

Obesity is a rising concern in the United States of America. Data from The National Health and Nutrition Examination Survey in 2007-2008 shows that approximately 34.4% of American adults over the age of 20 are overweight, and another 33.9% are obese (Flegal, Carroll, Ogden, & Curtin, 2010). Individuals with severe mental illness (SMI), like schizophrenia, are not exempt from the rising trends in obesity. On the contrary, these

individuals are more likely to be overweight or obese than the general population. Only 27% of the general population, compared to the 42% of a group of individuals with schizophrenia are considered obese, with a Body Mass Index (BMI) ≥ 27 (Marder et al., 2004). Risk factors for weight gain in individuals with SMI, specifically schizophrenia, are numerous including resources and knowledge deficits about a healthy diet, weight promoting anti-psychotic drugs, disruption in sleep and night eating.

Antipsychotic medications have numerous side-effects. The adverse effects of typical antipsychotics medications are severe in nature and include extrapyramidal symptoms, neuroleptic malignant syndrome, and agranulocytosis. A new classification of antipsychotics medications referred to as atypical antipsychotics, cause fewer of these severe adverse effects but come with their own side effects which can include insomnia, metabolic syndrome and weight gain.

Emerging research shows a relationship between chronic lack of sleep and hyperphagia as well as chronic lack of sleep and weight gain (Chaput, Klingenberg, & Sjödin, 2010; Koban, Sita, Le, & Hoffman, 2008; Palmese et al., 2011). Sleep loss can cause a transient state of insulin resistance, which may develop to type 2 diabetes mellitus (DM), when associated with overweight and obesity (Gutierrez & Willoughby, 2010). Sleep loss is also thought to increase appetite due to reduced levels of leptin, a hormone that is secreted from fat cells. When leptin levels are increased, as with high body fat mass and recent feedings, appetite is decreased and energy use is increased. When leptin levels are decreased which follows sleep loss, appetite may consequently increase. Another hormone that affects weight and is influenced by sleep is ghrelin, which is secreted by the stomach when there is an energy deficit to the body. In contrast with leptin, when ghrelin levels are *high*, individuals are more likely to feel an increase in hunger and have an increased appetite and consequently increase food consumption (Gutierrez & Willoughby, 2010).

Night Eating Syndrome (NES) is another condition that hinders weight loss in individuals with SMI. The condition, which was first coined by Dr. Albert Stunkard in 1955, is defined by: eating a minimum of one quarter of daily caloric intake late in the evening or at night after the evening meal; nocturnal awakenings with ingestions at least two times per week; distress or impairment of functioning; and awareness of the eating episode. Other sources also include insomnia, morning and daytime anorexia, feelings of guilt after nighttime eating, and carbohydrates as the majority of nighttime foods as part of diagnostic criteria (Allison et al., 2010; American Psychiatric Association, 2000; Stunkard, Grace, &

Wolff, 1955). Studies by Palmese et al. (2011) and Lundgren et al. (2010) found that overweight individuals with severe mental illnesses were at a high risk for Night Eating Syndrome. The pattern of intake in NES, and its association with insomnia puts the psychiatric population at great risk for weight gain especially when coupled with the appetite and sleep altering side effects of psychiatric medications.

Problem

Individuals with psychiatric disabilities die on average 25 years earlier than the general population (Marder, et al., 2004). Excess mortality is primarily by cardiovascular disease but also is influenced by other comorbid conditions such as diabetes, hypertension and obesity. Preliminary research shows a relationship between sleep and obesity which may interfere with weight loss. The relationship between poor sleep and night eating may play a role in success or failure of weight loss interventions in individuals with SMI.

Purpose

Recovering Energy through Nutrition, Exercise and Weight Loss (RENEW) (Brown, Goetz & Hamera, 2011) is a project designed to meet the weight loss needs of the underserved population of individuals with SMI. A goal of this project was to examine the efficacy of a maintenance and support program in achieving long-term weight loss in the SMI population. The purpose of this secondary review of data from RENEW, supported by the National Institute of Mental Health, is to examine if avoidance of night eating and self-report of sleep predicts weight loss.

Research Question

Will self-report of the frequency of getting enough sleep and avoidance of night eating predict weight loss?

Literature Review

Although Dr. Albert Stunkard first introduced NES in 1955, research on the topic experienced a period of relative latency for nearly half a century before researchers began to give critical attention to the disorder within the last decade and a half. The review of the literature focuses on the relationship between NES, sleep and weight loss in the general population and then summarized research with individuals who have sever mental illness.

A study by Gluck, Venti, Salbe, & Krakoff (2008) examined the prevalence of nighttime eating and its effect on weight change. Participants (N=160) were admitted to a clinical research unit where they were provided a personalized weight-maintaining diet for

three days prior to testing. During the final three days at the inpatient clinic, participants had free access to special vending machines for 23.5 hours per day in addition to core condiments, beverages, breads and spreads. These vending machines were stocked with foods that had a high hedonic rating based on participant responses to an 80-item food preference questionnaire. Participants were instructed to eat whatever they wanted and whenever they wanted as long as all vended items were consumed in the vending room. In this study, participants that had food intake from the vending machines between 2300 and 0500 were considered nighttime eaters (NEs).

At baseline, in the 45 NE participants, and 99 non NE participants there was no differences between the NEs and the non-NEs groups in body weight, percentage body fat, or BMI. On average, NEs had caloric intake of ≈15% (±3) between the hours of 2300 and 0500 and 61.5% of these calories came from carbohydrates. Individuals with NE gained significantly more weight from baseline to follow-up (3.4 lbs. ± 1.8). However individuals with NE increased body weight 3.1% per year from baseline compared to the 1.5% change in non-NEs (P= 0.04).

Wantanabe, Kikuchi, Tanaka, & Takashashi (2010) investigated the association between short sleep duration and elevated BMI and obesity in a sample of 35,247 Japanese men and women in a longitudinal study. Self-administered questionnaires were given at baseline and again at a one year follow-up period. Obesity was defined as BMI ≥ 25 per the International Obesity Task Force proposal of adult obesity in Asians. Of the original sample, data sets for 34,852 participants were complete and used for data analysis. Researchers report 20,023 non-obese men at baseline, compared to 1,171 new cases of obesity at 1 year follow-up. BMI was found to be significantly greater in participants who reported sleep in a range of <5 hours and up to 7 hours of sleep when compared to those with 7-8 hours of sleep. Linear regression analysis showed that among men, sleep duration less than 6 hours was associated with weight gain and obesity compared with men who had 7-8 hours of sleep. Also among men, sleep duration greater than 9 hours was associated with weight gain, relative to 7-8 hours of sleep. There was no relationship between short sleep duration and weight gain and obesity at a 1 year follow-up in women.

Rao, Blackwell, Redline, Stefanick, Ancoli-Isreal, & Stone, (2009) used a cross-sectional, observational study design to explore the association between slow wave sleep (stage 3 and 4 sleep; SWS) and BMI in 2745 men ≥65 years. Researchers focused on SWS because previous research found insulin resistance after selective SWS deprivation (Tasali,

Leproult, DA, & Cauter, 2008). Data were collected from single night in-home sleep studies using unattended polysomnography. Researchers found that SWS and BMI are negatively related, independent of total sleep duration; when SWS decreased, BMI significantly increased. The odds of obesity (BMI ≥ 30) were 1.4 times higher in participants in the lowest SWS quartile (0 to < 3.8% Total Sleep Time) when compared to participants in the highest SWS quartile (>16.7% Total Sleep Time). There was also an inverse relationship between SWS and waist circumference. There was no significant association between SWS and percentage total body fat or waist-to-hip ratio.

Rogers, Dinges, Allison, Maislin, Martino, O'Reardon, & Stunkard (2006) compared sleep in women with NES (n=15) with women in a control group (n=14) using polynomnographic and sleep questionnaires. Sleep and food diaries were also distributed to study participants during this 1- week outpatient study. The questionnaires included the Pittsburgh Sleep Quality Index (PSQI) and Multivariable Apnea Risk Index (MAP) to assess sleep quality and sleep disturbance; the Morningness- Eveningness Scale to indicate circadian preference; the Epworth Sleep Scale (ESS) to assess daytime sleepiness levels; and finally the Beck Depression Inventory to evaluate possible differences in depression between the NES group and the control group.

Participants with NES consumed food during nighttime awakenings while participants in the control group refrained from post- awakening food consumption. Participants with NES reported longer time falling asleep, shorter sleep duration, reduced sleep quality and increased sleep medication on the PSQI compared to the control group. On the MAP index, the NES group reported more daytime sleepiness compared to the control subjects ($p=0.003$). Despite no significant difference in circadian preferences, between the two groups, the NES group had reduced non-REM stage 2 and 3 sleep time compared to control group. This contributed to reduced Total Sleep Time as well as reduced sleep efficiency in the NES group.

Cappuccio and colleagues (2008) conducted a meta-analysis of 36 studies on short sleep duration and obesity in children and adults to examine the relationship of sleep duration and obesity in children and adults. Research studies were taken from Medline, Embase, AMED, CINAHL and Psychinfo. This yielded a large total sample size of 603,519 from 22 population samples in 17 different short sleep studies. Seven of 11 pediatric population samples reported a significant positive association between short duration of sleep and obesity. However, unlike studies in children, all of the studies in adults revealed a

consistent and significant negative association between hours of sleep and BMI (Cappuccio et al., 2008). This is the first systematic review of research focused on short sleep studies and weight. The meta-analysis demonstrates that there is consistent data of having increased odds of being a short sleeper in the obese adult population.

Since the meta analysis by Cappuccio et al. (2008), two subsequent studies report no relationship between NES and percent weight loss. Grave, Calugi, Ruocco & Marchesini (2011) tested the effect of NES diagnosis on weight loss outcome in obesity. The intervention group was comprised of 27 women who were diagnosed with NES and had a BMI of ≥ 40 or BMI range of 30-40 and two or more medical comorbidities. Non-NES individuals were matched on gender, age, and BMI made up the control group. The 21-day treatment included: a low calorie diet; 30 min of bicycle exercise per day, and two 45-min sessions of calisthenics per week. Psycho-educational groups helped participants reduce their speed of eating. Data gathered at baseline and at a 6-month follow-up period showed that 51.4% of participants with baseline diagnosis of NES no longer met diagnostic criteria at follow-up. The percent weight loss between individuals with NES and those without NES diagnosis did not differ at 6-month follow-up.

In a sample of 68 overweight (BMI ≥25) and obese (BMI ≥30) individuals with SMI, Lundgren et al. (2010) found that night eating was not associated with BMI. Researchers suggest that the lack of association may be attributed to the restricted BMI range, and recommend that future studies included individuals with NES of all weight ranges.

Night eating in individuals with serious mental illness

Lundgren, et al. (2006) studied the prevalence of NES in a psychiatric population and its relationship to antipsychotic medication use. A sample of 399 participants from psychiatric outpatient clinics at the University of Pennsylvania, and the University of Minnesota were screened using the Night Eating Questionnaire (NEQ), and those who scored above 20 points (of a possible 56) were selected for further evaluation and the Night Eating Syndrome History and Inventory (NESHI) was used for NES diagnosis. Subjects were diagnosed with NES if one of two criteria were met: evening hyperphagia or ingestion of food after nocturnal awakening that occurred three or more times per week. More than half,121 participants, of the 205 participants that scored above 20 points on the NEQ were available for the follow-up. Of the 121 participants, 49 were diagnosed with NES, while 28 had sub-threshold NES and the 44 participants were not diagnosed with NES. The positive

predictive value of the NEQ with a cutoff of 20 was 40%, but increased to 60% when the cutoff score was 38.

Lindgren and colleagues (2006) also found that a greater proportion of participants with NES were prescribed atypical antipsychotic medications than those without the syndrome (38% versus 30.8%, respectively; $\chi 2 = 6.24$, df=2, p=0.04). These medications include aripiprazole, olanzapine, quetipine, risperidone, and ziprasidone. Furthermore, researchers also found that there appeared to be no difference in the percentage of participants using weight-promoting agents versus other antipsychotic medications. Researchers reported a positive relationship between NES and BMI. NES is five times higher (Wald=13.3; $p<0.001$) in obese participants (BMI $\geq$ 30) than in normal weight participants with psychiatric disabilities. In addition, overweight participants were 2.5 times (Wald=3.5; p=0.06) more likely to meet NES criteria than normal-weight participants.

RENEW (Brown, Goetz, & Hamera, 2011) is a weight loss program that includes a 12-weeks intensive intervention, followed by a 12-weeks maintenance phase and finally 6 months of intermittent supports. During the intervention, participants receive individualized diet plans, dietary education, 30-45 minutes of moderately intense activity 3-5 days per week, as well as frequent contact between professionals and other participants. Resources that were provided to the participants include two main-meal replacements per day. In order to promote physical activity, exercise equipment and tracking devices also were provided throughout the study.

Brown, et al. (2011) examined the efficacy of the RENEW intervention in a randomized controlled trial of 89 individuals with SMI who were completing the maintenance phase. The intervention group had an average weight loss of 5.3lbs at three months, with one participant loosing as much as 34.5lbs. At six months, the average weight loss from baseline was 4.4lbs in the intervention group. The average weight of the control group did not vary significantly at three and six months: 0.1lb weight gain and 0.1lb weight loss, respectively.

Methods

The present secondary data analysis from the Recovering Energy through Nutrition, Exercise and Weight Loss intervention will examine the relationship of NES with sleep and its effect on weight loss.

Sample

Participants from the original study were recruited from four community support programs with services to individuals with severe mental illnesses (SMI). Three of these programs were based in the Kansas City area and one program was based out of Las Vegas. A written informed consent was obtained from participants after a complete description of the study was given to those who were recruited. The study protocol was approved by the institutional review boards of the University of Kansas Medical Center and the University of Missouri-Kansas City. Participants were stratified on the use of typical and atypical antipsychotic medications and randomly assigned to the control group.

In this secondary data analysis of RENEW, only data from participants in the original intervention group from baseline to three months was analyzed. The sample included 34 adults (female=19, male=15) with psychiatric diagnoses of Bipolar Disorder, Schizophrenia Spectrum Disorder, Major Depressive Disorder (n=10, 18, 6, respectively). The average age of participants was 44.9 (range 19-64, SD= 11.85). The majority of the population is Caucasian/White (n=20), but also included African American/Blacks (n=13) and Multi-Racial (n=1) individuals as well.

Measures

The Health Promoting Lifestyle Profile II (HPLPII) was developed in 1987 to measure health behavior of participants (Walker, Sechrist, & Pender, 1987). The 52-item survey measures six dimensions of health behavior: Self-Actualization, Health Responsibility, Exercise, Nutrition, Interpersonal Support and Stress Management. One of seven items on the Stress Management subscale, asks participants to indicate the frequency they "Get enough sleep" and is ranked as "Never= 1, Sometimes= 2, Often= 3, or Routinely= 4."

Walker & Hill-Polerecky (1996) reports the stability of the HPLPII with a three-week test-retest stability coefficient of 0.892. The alpha reliability coefficient for the total scale is 0.943 which indicates that items are measuring a similar construct. Jensen, Decker and Andersen (2006) also found a strong relationship among items on the HPLPII, with a Cronbach's alpha of 0.92, and a Cronbach's alpha of 0.86 on the Stress Management subscale.

Behavioral and psychological symptoms of Night Eating Syndrome (NES) are measured with the Night Eating Questionnaire (NEQ) (Allison et al., 2008). The most current version of the 13-item self-report NEQ measures nocturnal ingestions, evening

hyperphagia, morning anorexia, and mood/sleep. Each item is scored from 0-4 with a total score ranging from 0-52.

The NEQ internal consistency reliability score (alpha= 0.70) is acceptable and correlates with evening caloric intake percentage, number of nocturnal ingestions, morning hunger, disturbed eating attitudes and behaviors, sleep quality, mood and perceived stress (Vander Wal, 2012). A positive predictor value (PPV) measures the likelihood that someone has NES. The scale has a PPV of 72.7% with a total questionnaire score of greater than 30. When the cutoff is lowered to 25, the PPV drops to 40.7%. Although the NEQ is a well-recognized measure to screen for NES, it does yield a high number of false positives among obese samples.

Participant weight was measured as an average of three digital readings from a Seca Platform scale, model 707. Participants were instructed to wear regular clothing, and asked to remove shoes prior to stepping on the scale.

Demographic data collected from participants included: age, gender, weight, ethnicity, education, psychiatric diagnoses, psychiatric medication use and shift work. Primary psychiatric diagnosis was based on criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM) – IV (American Psychiatric Association, 2000) and retrieved from chart data.

Procedures

Measures were administered individually to participants who completed the questionnaires and weight going from station to station in large rooms. Both the HPLIII and NEQ were read to participants compensate for reading difficulties.

Data Analysis

This secondary data analysis uses data collected from the HPLPII sleep item, total scores from the NEQ, and weight difference from baseline to three months. Descriptive statistics of scores was computed using SPSS.

Multiple regression was to be computed with weight as the dependent criterion variable and total score from the NEQ and frequency of getting enough sleep from the HPLPII as independent predictor variables.

Results

The mean sleep score from the HPLPII was 3.08 on a scale of 1-4. Scores from the Night Eating Questionnaire ranged from 4-24 with a mean of 16.3. Participants had a wide range of weight loss scores ranging from losing 34.5lbs to gaining 7.5lbs (M= -6.75, ± 10.34). Table 1 shows the ranges, means, and standard deviation for the HPLPII, NEQ, and weight loss.

Correlations were calculated among measures are shown in Table 2. A significant negative correlation of -.344 (p=.05) was found between self-report of getting enough sleep per the HPLPII and weight loss at three months (N=34) while the correlation of between NEQ and weight loss was not significant (R=.354, n=12).

A bivariate regression was calculated to determine how much sleep accounted for weight change. Results from the regression show a low R^2 of .119, indicating that sleep accounts for very little weight change.

Discussion

This is the first study of its kind to look at sleep as a predictor variable for weight loss in individuals with severe mental illnesses. This secondary data analysis assessed the relationship between sleep and night eating on weight loss in individuals in a weight loss program. Analysis of data show that there is a significant negative correlation between weight loss and self-report of getting enough sleep however self-report of sleep only predicted 12% of the variance in weight loss. There were too few participants who completed the NEQ at 3 months to determine if avoidance of night eating predicted weight loss.

The Heath Promoting Lifestyle Profile II asks about participants' perception of sleep from the past month. Scores from HPLPII sleep item ranged from 1-4 (possible range 1-4). The obtained mean value of 3.08 suggests that participants, as a whole, felt as though they were 'often' getting enough sleep. The findings in this study are not supportive of the literature that identifies a relationship between insomnia and NES (Palmese, et al., 2011).

Limitations of this study include a small sample size, and the use of measures that were inadequate in testing the hypothesis. The small obtained range of total score from the Night Eating Questionnaire was low (0-24) with the possible score ranging from 0-52. The positive predictive value of the NEQ is 62% using a cutoff score of 25 in a psychiatric population (Allison, et al., 2008). Per these guidelines, none of the participants in the

present study met criteria for Night Eating Syndrome. Using a two-stage assessment of NES might provide better data, for example using the NEQ as a screening tool, and the Night Eating Syndrome History and Inventory to confirm diagnosis. Another limitation of this study is measuring sleep with a one-item question from the HPLPII. The sleep item asked participants to rate how often they got enough sleep in the past month.

In future studies, a more robust measure of sleep such as the Pittsburgh Sleep Quality Index would provide a larger range of sleep scores while measuring various aspects of sleep. Using both subjective and objective sleep data can also enrich future studies. We would also propose using a prospective study design so that sleep can be measured at regular intervals while participants were enrolled in a weight loss intervention to see if the two variables fluctuated equally.

Conclusion

Individuals with severe mental illness are at a great risk for many health issues including those conditions that are exacerbated by overweight and obesity. Compounding health deficits are problems of use of psychiatric medication, poor sleep and night eating. We found that sleep accounts for very little weight change, and is therefore a poor predictor of weight loss as it was measured in this study. Future studies are needed to further investigate the nature of these factors and determine if improving sleep would have any beneficial effects on weight loss maintenance in this population.

Table 1 Means, Standard Deviations and Obtained Ranges for HPLPII Sleep Item, NEQ, and Weight Loss

	Possible Range	Mean	Standard Deviation	Obtained Range
"Get enough sleep" from HPLPII at 3 months	0-4	3.08	.90	1-4
Night Eating Questionnaire	0-52	16.3	6.01	5-24
Weight Loss*	Not limited	-6.75	10.34	(-34.50)-(+7.50)

*3 month weight subtracted from baseline weight

Table 2 Correlations between weight loss and report of getting enough sleep, NEQ, and weight loss at three months

	NEQ Score	Weight Loss at 3 months
"Get enough sleep" at 3 months	-.507	-.344*
NEQ Score	--	.354

* Correlation is significant at the 0.05 level

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