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Exploring the Typology of Night Eating Syndrome

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Abstract

Objective: There is an ongoing debate about the definitions and clinical significance of night eating syndrome (NES). This study explored potential subtypes based on night eating patterns and features reported to be associated, with NES in a representative community sample of 8,250 individuals aged 15–39 years.

Method: Latent class analysis was used to identify NES subtypes among 2,068 participants who reported night eating behavior.

Results: A four-class solution was judged best. Two classes appear to characterize individuals who eat very late or eat a large proportion of their daily intake after 7 pm, and two other classes are characterized by high rates of depressive symptoms. Results do not support an association between night eating and obesity in young adults. Late night eating is associated with high caloric intake, high sodium intake, and low protein intake.

Conclusion: Evidence supports the validity of a definition of NES based on eating very late at night.

Keywords

night eating behavior; obesity; eating disorders; depression; 24-h food diary

Introduction

Night eating syndrome (NES) was introduced by Stunkard et al.[1] to characterize a clinical disturbance that seemed to have caused or contributed to the maintenance of obesity in a subset of severely obese patients. The defining features of NES were “evening hyperphagia” or night eating, morning anorexia, and sleep disturbance. NES appears to be more common

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among individuals requesting treatment for obesity compared to nonobese individuals, yet studies of community populations have not consistently found an association between NES and obesity.[2-4] Several studies have elaborated on the description of NES, noting in particular mood disturbance as a possible associated feature, yet to date no uniformly accepted definition of NES has emerged.[5-9] Recently, Stunkard and colleagues[10] introduced a simplified definition of NES, requiring only the presence of the behavioral symptom of evening hyperphagia (eating a disproportionately large amount of calories after dinner or having nocturnal eating episodes).[2,11] Hence, it remains unclear which symptoms comprise NES.

One aim of the present study was to examine, in a large, representative sample of young adults, whether the clinical features of NES cluster into meaningful subtypes. It is possible, for example, that obesity is a feature of NES rather than being characteristic of all individuals with night eating behavior. Consistent with efforts to arrive at an empirically based classification of bulimic symptoms,[12-14] latent class analysis (LCA)[15,16] was used in the present study to identify classes or subtypes of "night eaters" among individuals who had participated in the National Health and Nutrition Examination Survey III (NHANES III).[17] In the absence of a uniformly accepted definition of NES or of night eating (the necessary symptom for classification), multiple behavioral and affective symptoms that have been used to define NES in previous studies[5] were included in the LCA, including two definitions of night eating, breakfast skipping (as a proxy for "morning anorexia"), several indicators of sleep or mood disturbance, and obesity (BMI equal or greater 30).

In patient samples, NES also has been reported to be associated with elevated rates of psychiatric comorbidity, notably depression[5,10] and, in a recent study, substance use disorder.[11] Whether such associations reflect help-seeking behavior within the NES population or are characteristic of NES in general can be determined only by studies conducted with community samples. Thus, a second aim of this study was to examine the relationship between night-eating and mood disorders or substance-use disorders in a nonclinical sample.

Tanofsky-Kraff and Yanovski[9] noted that suggestions that NES should be considered an eating disorder have not yet been supported by empirical data showing evidence of distress or functional impairment arising from NES. They proposed to distinguish eating disorders, which require distress or impairment, from "nonnormative eating patterns," of which NES would be an example. In the case of NES, there may not be associated distress, but it is nevertheless a syndrome of public health significance by its contribution to inadequate nutrient intake or obesity. They recommended examination of energy intake and macronutrient intake in night eaters. As a third aim, the present study examined whether night eaters, compared to nonnight eaters, consume excessive calories overall or eat a diet that differs in nutrient content or cholesterol in ways that might impair health. In addition, self-rated overall health was used as an indicator of impairment.

Method

Participants

The analyses used data from the participants in NHANES-III with valid data required for the present study, namely 24-h dietary recall and diagnostic information. The design of NHANES-III has been described else-where.[17] Briefly, NHANES-III involved 33,994 respondents in 89 geographic areas in the U.S. covering the entire lifespan (ages 2 months and older). The survey data were collected over a 6-year period (1988–1994). Only participants aged 15–39 years (N = 8,786) were asked to complete the Diagnostic Interview Schedule (DIS),[18] a structured interview assessing psychiatric disorders. In all, 8,449 (96.2%) completed the DIS, and of those 8,250 (97.6%) had complete, reliable 24-h dietary recall records.

Of the 8,250 respondents included in the present study, 2,068 (25.1%) exhibited night eating (defined as either eating 50% 1 of total daily kilocalories after 7 pm, or any eating after 11 pm[6]) and were used in the LCA. The remaining 6,182 participants were classified as nonnight eaters and served as a comparison group in validation analyses comparing night eaters (NEs) and nonnight eaters (NNEs).

Instruments and Procedure

Each survey participant was interviewed at home and asked to participate in a medical examination, which included measurements of height and weight, the DIS, and a 24-h dietary intake recall. Respondents reported all foods and beverages consumed, except plain drinking water (i.e., not bottled) for the previous 24-h time period (midnight to midnight), along with time of day of the eating episodes. Dietary recalls were examined by trained interviewers, to ensure that they were as complete as possible; diaries were deemed incomplete if information about one or more foods or beverages was not obtained. The National Center for Health Statistics made final determinations regarding the completeness and reliability of the dietary recalls. Night eating was defined as eating (1) 50%1 of the total daily calories between 7:00 pm and 4:59 am or (2) anything between 11:00 pm and 4:59 am, regardless of amount of calories consumed. Because the NHANES-III food recalls covered a 24-h period from 12:01 am until the next midnight, “night” was defined as the union of two time segments, 12:01 am to 4:59 am, plus 7:00 pm or 11:00 pm (depending on the definition) to midnight. All days of the week were represented in the food diaries; Saturday was the most frequently sampled day (26.6% of all diaries) and Monday was the least frequently sampled day (7.8%).

The depression and mania modules from the DIS-Version III[18] were administered by trained interviewers. This highly structured interview was designed to assess the prevalence of psychiatric disorders in both clinical and normal populations. The data from the DIS permit mood disorder diagnoses based on the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III). To assess illicit substance use, we used answers to two questions, “Have you ever used marijuana?” and “Have you ever used crack or cocaine in any form?” Binge drinking was assessed based on answers to the question “In the past 12

months, how many days of the year did you have five or more drinks on a single day?"; respondents were categorized as having done so 0 days, 1–10 days, or 11 or more days.

To assess general health, we used responses to the question, "Would you say your health in general is excellent, very good, good, fair, or poor?"

Data Analyses

Latent Class Analysis.—LCA is an exploratory method used to identify classes or subtypes of night eating symptomatology. The classes are "latent" because class membership is not directly observed; rather it is inferred (probabilistically) based on an individual's pattern of responses across a selected set of variables. LCA identifies a set of latent classes as well as estimating individuals' probability of being in each such latent class. In LCA, an attempt is made to find the smallest number of latent classes that adequately describe associations in a set of observed categorical variables.[15] The optimal LCA solution, judged using indices such as the Bayesian information criterion (BIC), minimizes model misclassification errors without sacrificing parsimony. LCA was conducted using the Mplus software package.[16] To ensure that the LCA results did not represent a local minimum, the analysis used 10 different sets of random starting values; the final analysis used the results from the set with the highest log likelihood as the starting values. Following the LCA approach described by Muthén and Muthén,[15,16] LCA solutions with different numbers of latent classes were tried, and the "best" solution was selected based on minimizing BIC and evaluating average probabilities of class membership (the closer to 1, the better).

Because the goal of the analysis was to identify possible subtypes of the night eating population, similar to the approach of Sullivan et al.,[19] LCA in this study included only respondents classified as NEs by the criterion mentioned earlier. LCA was conducted using binary (yes/no) measures of eating at night (eating 50% 1 kilocalories after 7 pm, or any eating after 11 pm), breakfast skipping (as an indicator of "morning anorexia," defined as eating nothing between 5 am and 11 am), obesity (BMI equal to or greater than 30), felt depressed in the past 2 weeks, experienced appetite loss, and three questions having to do with sleep disturbance or tiredness in the past 2 weeks (always tired; trouble sleeping; cannot sleep/not tired). No responses that could have missing data due to planned skip patterns were included in the LCA, to avoid violation of the assumption of local independence.

Validation.—Once subtypes are identified, the issue is whether the clinical validity can be documented for all or some of the proposed subtypes. Subtypes were compared on demographic variables (age, race/ethnicity, gender) and on DSM diagnoses of mood disorders (major depression and dysthymia) for purposes of description. Subtypes were then compared on variables that could support or challenge the validity of the subtypes (referred to as "validators"): self-reported substance use (lifetime marijuana and cocaine use, and number of days drinking 51 alcoholic drinks in the past year coded as 0 days vs. 1 or more days); self-reported overall health; and nutrient intake variables (daily consumption of total energy, percent of total energy intake from protein, carbohydrate, fat, and sucrose, and total daily intake of cholesterol and sodium).

The first question relates to whether the NEs differ from the NNEs on the validator variables, which might bear on the validity of the NE diagnosis as a whole. The second question is whether the proposed subtypes of NE differ from each other, and if so, whether evidence supports the validity of some or all of the subtypes as diagnostic of NES.

Overall tests of differences among groups were done using analysis of variance or logistic regression models. A two-tailed 5% significance level was used as the criterion in all testing procedures. Because this is designed as an exploratory (hypothesis-generating) rather than a hypothesis-testing study, no correction for multiple testing was used. The number needed to take (NNT)[20-22] is reported as an effect size that can be used for both categorical and dimensional measures. NNT = +1 indicates perfect discrimination between two groups. As a "rule of thumb" in epidemiological studies, generally NNT < 10 indicates strong association, 10 < NNT < 20 indicates moderate association, and NNT above 20, a weak association. All analyses took the survey design into account, as specified by the NHANES-III analytic guidelines,[17] except for the effect size estimates reported in Table 5, because we are not aware of a validated method for computing effect size estimates for main effects and interactions with complex sample data.

Results

Prevalence of Night Eating Symptoms in NHANES III

Table 1 shows the distribution of each of the symptoms that were used in the LCA, among the NEs and the NNEs. Of the 8,250 participants, 2,068 individuals (25.1% unweighted, 25.8% weighted) either consumed 50% or more of their total daily caloric intake after 7 pm and/or reported eating anything after 11 pm. Data from these 2,068 NE were used for the LCA. It should be noted that eating 50% or more after 7 pm and eating anything after 11 pm were correlated behaviors (odds ratio = 2.85), i.e., individuals who did one were more likely to do the other as well. Breakfast skipping was significantly higher among NEs than among NNEs ($p < .0001$), and symptoms of depression were slightly higher among NEs than among NNEs ($p < .05$). The prevalence of obesity did not differ significantly between the NE and NNE groups.

LCA to Identify Subtypes of Night Eating Symptomatology

The four-class LCA solution was judged best, based on minimizing BIC and average class membership probabilities (>.80). The percent of individuals in each class having each symptom is shown in Table 2. The largest class (almost one-half of all NEs) represents a group of individuals who all report eating after 11 pm, many of whom skip breakfast (about 40%), and about a third who also consume more than 50% of the daily caloric intake after 7 pm. Only a minority of individuals in this class report mood or sleep disturbance. This group will be called "nondepressed *late night* eaters."

The second largest class (about one-fourth of all NEs) includes individuals who all eat more than 50% of their daily caloric intake after 7 pm, but who do not eat late at night. Similar to the late night eaters, individuals in this group endorse few mood or sleep symptoms. They will be referred to as the "nondepressed *evening* eaters."

A third class includes individuals who uniformly report eating after 11 pm, and about one-fourth of whom also eat 50% or more of their daily intake after 7 pm. Most individuals in this group are depressed and experience trouble sleeping. About half indicate feeling always tired or indicate loss of appetite. This group will be called "*depressed late night* eaters."

The fourth class is composed of individuals who report eating more than 50% of their intake after 7 pm but deny eating after 11 pm. Most individuals in this group report feeling depressed, about half indicate that they are always tired, and about 80% experience trouble sleeping. This group is referred to as the "*depressed evening* eaters."

Differences among the four classes are shown in Table 2; for each comparison, at least one class differed significantly from another class on every symptom included in the LCA, except obesity. Specific class differences are indexed by superscript, whereby different superscripts indicate significant group differences and same superscripts indicate nonsignificant findings.

Descriptive Statistics

Table 3 presents descriptive statistics for the four proposed subtypes of night eaters, the total NE group, and the NNE group. Statistically significant differences were found for gender, ethnicity, and age, with NE more likely to be non-Hispanic black, male, and younger than NNE (all moderate to weak effects). As a group, NEs are likely to have a lower, not higher, BMI than NNEs, and the effect size for this was moderate to weak.

Validation of Syndrome

In Table 4 the subtypes, as well as the total NE and total NNE groups, are compared on "external validator" variables. In comparing the total NE group with the total NNE group, it can be seen that NEs are more likely to use marijuana or crack/cocaine (a moderate effect), but less likely to binge-drink (>5+ drinks in a day, a strong effect). Strong differences were found in total calorie intake per day which was greater among NE, and moderate effects were observed for intake of sodium (elevated among NEs) and intake of protein (reduced among NEs).

Validation of the Subtypes

The descriptive statistics on possible validators of the subtypes appear in Table 4. Any external validator that was found to significantly differentiate the four subtypes ($p < .05$) is reconsidered in Table 5, where the effect sizes due to depression, late night eating, and their interaction are separately considered. It appears that differences in the use of marijuana and overall health are primarily related to depression, while the differences in the nutritional profile (energy and cholesterol intake, and percent of calories from protein and carbohydrate) are more consistently related to late night eating.

Conclusion

This paper addressed the question of whether night eating symptoms cluster into meaningful subtypes and whether all or only some of the subtypes relate to a NES. The variables considered to define the clusters included patterns of night and morning eating, as well as sleep, mood, and BMI that have been reported to be strongly associated with NES. To test the validity of the syndrome subtypes, illicit substance use, binge drinking, self-rated overall health, and caloric-, macro-, and micronutrient intake were examined.

Results suggest that the core behavioral symptom of NES, evening hyperphagia, is widely prevalent among young adults. LCA identified four distinct NE classes based on the pattern of night eating and variables reflecting depression. Obesity was not associated with any of the four classes or with night eating in general. Indeed, NEs as a group had lower BMI than did those not identified as night eaters, and there was no distinction among the four subtypes on BMI. BMI does not seem relevant to the definition of NE or to subtypes of NE in young adults.

About 25% of young adults met criteria for night eating, defined as consuming 50% or more of daily calories after 7 pm or eating anything after 11 pm. This suggests that classification of NES based entirely on night eating, so defined,[23] will identify a fairly large segment of the population. However, analyses indicate that the two subtypes involving late night eating (eating anything after 11 pm) accounted for much of the discrimination between NEs and NNEs, and if used to define NES, would result in a prevalence of 14.5% among young adults.

Generally, those identified as NEs and NNEs differed in several ways. Night eating was found to be more common among men and black participants and NEs were slightly younger than NNEs. NEs had somewhat elevated rates of marijuana and cocaine but tended to have lower rates of binge drinking. NEs consumed an average of 300 more calories, and their diets contained slightly less protein (0.5%) and 300 mg more sodium than diets of NNEs. Yet, despite the elevated caloric intake, night eating was not found to be associated with obesity. The cross-sectional nature of the data precludes testing the hypothesis that night eating poses a risk for future poor health outcomes arising from increased caloric intake or sodium intake such as diabetes, hypertension, or obesity.

When one compares the late NEs with the evening NEs and the NNEs, it becomes clear that the late NEs stand out in a number of ways. The late NEs on average consume 433 calories per day more than do NNEs, 492.1 mg more sodium, 0.9% less protein, and 33.8 mg more cholesterol than do NNEs. This suggests that a NES definition would better be based on late night eating.

Yet, there were no significant differences in BMI or in a self-rated overall health, either between those identified as NEs and NNEs, or among the four subtypes of the NEs.
We note that our analysis included data from younger populations than typically are included in studies of NES. Whether persisting with such dietary patterns in the long run would have serious consequences would require both more specific biological studies in a

cross-sectional sample (lipid levels, blood pressure, blood glucose levels, etc.), as well as longitudinal studies to detect onset of diabetes or cardiovascular disease.

Stunkard's group has reported elevated symptoms of depression among individuals reporting night eating, typically in clinical samples where high rates of depression may be expected.[3,10,11,24] Yet, our results suggest that mood disturbances are only slightly higher among NEs than among NNEs. We further found that the mental health correlates associated with NE (e.g., substance use) appears to be largely a function of depression rather than night eating per se.

We found that NEs were more likely to use marijuana and cocaine. One recent study found marijuana use related to both increased appetite and higher daily caloric intake[25] and Di Marzo and Matias[26] point out that the endocannabinoid system controls food intake via both central and peripheral mechanisms, which may account for increased appetite in marijuana users. Hence, it is possible that the association of marijuana use and late night eating found in our study reflects the increased appetite in marijuana users. Cocaine, on the other hand, has been shown to be related to suppression of appetite,[27] which may be related to for the (non-significantly) lower BMI and obesity rates in the night eating group. Recent evidence finds that multiple neurotransmitter systems interact, suggesting that norepinephrine systems may interact with dopamine systems to enhance the activating effects of psychostimulant drugs.[28] It would be of interest to study night eating behaviors and weight trajectories in groups of drug-addicted individuals to more clearly differentiate the role of marijuana and cocaine in NEs.

Several limitations need to be considered in interpreting these findings. Based on a single 24-h dietary recall record, the NHANES data do not permit identification of recurrent night eating or of nocturnal eating after having fallen asleep. Moreover, the data do not contain measures of night eating due to shift or night work, although the fact that Saturdays were overrepresented among the days of the week may have somewhat mitigated against this possibility. In our findings, sleep disturbance is associated with depression rather than with the pattern of night eating, but a more detailed assessment of sleep disturbance (including observational data) would be needed to better describe the relationship between sleep disorders and NES. Finally, the cross-sectional design of NHANES precludes testing the predictive validity of NES subtypes in relation to clinical indicators such as obesity and its associated health outcomes.

These limitations are offset by several strengths. This is the first attempt at empirical classification of NES using a large, representative sample of young adults residing in the United States. The availability of interview-based data of mood disorders and alcohol or marijuana use in a nonpatient sample as well as the availability of nutritional data and objective height and weight measures further strengthen the study.

In conclusion, our study finds that night eating is a fairly common behavior in young adults. NEs differ from NNEs in relation to demographic variables, mood and substance-use symptoms, and intake of some nutrients. However, obesity was not associated with night eating in this sample. The discrimination between NEs and NNEs is particularly salient in

the two subtypes identified in the LCA by late night eating, suggesting that the diagnosis of NES seems best defined by this behavior.

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TABLE 1.

The prevalence of night eating symptoms in participants aged 15–39 years

		Prevalence in Night Eaters, *n* = 2,068 (%)	Prevalence in Nonnight Eaters, *n* = 6,182 (%)
Eating 50+ after 7 pm	Eating anything after 11 pm		
No	No	0.0	100.0
No	Yes	40.4	0.0
Yes	No	42.6	0.0
Yes	Yes	17.0	0.0
Breakfast skipping *		31.9	17.3
Felt depressed 2 weeks **		43.2	37.5
Always tired		27.9	26.0
Trouble sleeping		26.5	23.6
No sleep		16.3	14.8
Lost appetite		14.9	13.2
BMI ≥ 30		13.8	17.5

* $p < .0001$

** $p < .05$.

TABLE 2.

Percent exhibiting each symptom associated with night eating by subtype (class) of night eating as identified by latent class analysis

	Consuming 50%+ kcal* After 7 pm (%)	Eating After 11 pm* (%)	Felt Depressed 2 Weeks* (%)	Always Tired* (%)	Trouble Sleeping* (%)	Lost Appetite* (%)	No Sleep, Not Tired* (%)	Skipped Breakfast* (%)	Obese (%)
Depressed evening eaters (n = 296)	100.0[a]	1.4[a]	86.5[a]	70.0[a]	53.2[a]	34.7[a]	31.7[a]	24.6[a]	16
Nondepressed evening eaters (n = 578)	100.0[a]	0.0[b]	20.2[b]	6.7[b]	9.1[b]	1.7[b]	4.0[b]	27.6[a]	12.5
Nondepressed late night eaters (n = 864)	31.6[b]	100.0[c]	28.3[c]	16.8[b]	8.9[b]	2.1[b]	12.3[c]	39.8[b]	14.1
Depressed late night eaters (n = 330)	24.0[b]	100.0[c]	84.3[a]	56.6[a]	78.7[c]	53.5[c]	34.8[a]	25.9[a]	13.5

*At least one class differs from one other class (H_0: $\mu_{class1} = \mu_{class2} = \mu_{class3} = \mu_{class4}$), $p < .005$. When the overall test was significant, indicating that at least one class differed from one other class, post hoc contrasts were used to compare the percentages for each pair of classes. For a given variable (column), classes with different superscripts were significantly different from one another ($p < .05$).

TABLE 3.

Proportion or mean and standard deviation for demographic characteristics, BMI, and depression by subtype (class) of night eating as identified by latent class analysis, and comparing all nonnight eaters (total NNE groups) with all night eaters (total NE groups)

	Mean Age (years)	Female (%)	Non-Hispanic White (%)	Non-Hispanic Black (%)	Hispanic (%)	BMI	DSM-III Dysthymia (%)	DSM-III Major Depression (%)
Depressed late night eaters (n = 330)	27.3 ± 7.2	46.3	71.6	16.9	10.2	24.6 ± 6.1	18.6	32.9
Depressed evening eaters (n = 296)	28.0 ± 7.2	52.1	75.2	14.8	8.1	25.4 ± 6.4	23	28.1
Nondepressed late night eaters (n = 864)	26.2 ± 7.0	36.8	68.7	17.3	10.5	24.9 ± 5.8	2.5	1.1
Nondepressed evening eaters (n = 578)	27.2 ± 7.1	48.6	67.7	14.3	13.7	24.5 ± 5.5	0.5	0.1
Total NE (n = 2,068)	26.9 ± 7.1	43.8	69.8	16	11	24.8 ± 5.9	7.4	9.8
Total NNE (n = 6,182)	27.7 ± 7.2	53.5	71.7	11.9	12.5	25.4 ± 6.0	5.7	8.2
NNT[a]:NE vs. NNE	+44.4 *	+10.3 **	+53	−24.2 **	+66.8	+18.1 *	−57.3	−64.1

[a] NNT = ±1 indicates perfect discrimination between NEs and NNEs. Positive NNT means that NNE group has response greater than NE group; negative that NE group has response greater than NNE group. As a "rule of thumb" in epidemiological studies, |NNT| ≤ 10 indicates strong, 10 < |NNT| ≤ 20 moderate, and |NNT| > 20 weak association.

* $p < .01$

** $p < .001$ (no differences were significant at $0.01 \leq p < 0.05$).

TABLE 4.

Mean of variables that pertain to the validity of the syndrome and subtypes

	Ever Used Marijuana (%)	Ever Used Crack/ Cocaine (%)	0 Day 5+ Drinks (%)	Overall Health (1 = Poor, 5 = Excellent)	Energy (kcal)	kcal from Protein (%)	kcal from Carbohydrate (%)	kcal from Fat (%)	kcal from Sucrose (%)	Cholesterol (mg)	Sodium (mg)
Depressed late night eaters (n = 330)	67.4	26	32.5	3.6 ± 1.0	2765.6 ± 1555.6	13.1 ± 4.5	50.8 ± 10.5	32.7 ± 9.0	10.8 ± 7.5	327.1 ± 310.6	4265.0 ± 2994.3
Depressed evening eaters (n = 296)	68.5	27.8	27.7	3.5 ± 1.1	2670.1 ± 1407.9	14.2 ± 5.2	46.8 ± 11.9	33.1 ± 9.8	8.7 ± 7.8	303.0 ± 259.1	4059.1 ± 2369.3
Nondepressed late night eaters (n = 864)	52.3	20.3	35.7	3.8 ± 1.0	2829.2 ± 1470.5	14.1 ± 4.4	49.3 ± 10.6	32.6 ± 8.8	9.9 ± 6.6	346.7 ± 343.7	4322.6 ± 2686.1
Nondepressed evening eaters (n = 578)	51.7	16.7	46.6	3.9 ± 0.9	2448.1 ± 1034.9	14.6 ± 4.7	47.6 ± 10.9	34.3 ± 9.2	9.4 ± 6.4	274.7 ± 238.9	3939.0 ± 2172.0
Total NE (n = 2,068)	56.9	21.3	37.1	3.8 ± 1.0	2686.9 ± 1391.2	14.1 ± 4.6	48.7 ± 10.9	33.2 ± 9.1	9.7 ± 6.9	316.7 ± 304.1	4165.9 ± 2586.9
Total NNE (n = 6,182)	50.8	15.2	49.3	3.7 ± 1.0	2378.5 ± 1112.2	14.7 ± 4.8	49.4 ± 10.6	33.4 ± 8.9	10.1 ± 7.1	307.5 ± 275.0	3814.6 ± 2086.7
NNT[a]:NE vs. NNE	−16.5 *	−16.5 **	+8.2 **	−33.4	−6.4 **	+14.1 *	+27.1	+66.5	+34.2	−50.3	−10.5 **

Notes: Percentage or mean and standard deviation are presented in each cell. Number needed to take (NNT) comparing all night eaters (total NE) and all nonnight eaters (total NNE) is presented with indicators of the level of significance for this comparison.

[a] NNT = ±1 indicates perfect discrimination between NEs and NNEs. Positive NNT indicates that NNE group has response greater than NE group; negative that NE group has response greater than NNE group. As a "rule of thumb" in epidemiological studies, NNT ≤ 10 indicates strong association, 10 < NNT ≤ 20 indicates moderate association, and NNT > 20 weak association.

* $p < .01$

** $p < .001$ (no differences were significant at the $0.01 \leq p < 0.05$ level).

TABLE 5.

Comparison of the proposed subtypes on possible validation criteria on which the four groups significantly ($p < .05$) differ

Measure	Effect Size Estimate (Statistical Significance)		
	… Main Effect Depression	… Main Effect Night Eating Pattern	… Depression by Night Eating Pattern Interaction
***Ever used marijuana	1.48 (†††)	1.18 (n.s.)	1.28 (n.s.)
**0 days 5+ drinks	0.811 (n.s.)	0.813 (n.s.)	1.14 (n.s.)
***Health	−0.17 (†††)	−0.003 (n.s.)	0.13 (n.s.)
**Energy (kcal)	−0.025 (n.s.)	0.512 (†††)	−0.19 (n.s.)
**% kcal from protein	−0.16 (†††)	−0.14 (††)	−0.10 (n.s.)
*% kcal from carbohydrates	0.13 (††)	0.11 (†)	−0.02 (n.s.)
*Cholesterol	−0.08 (n.s.)	0.39 (†††)	−0.15 (n.s.)

Notes: Effect size estimates are presented, with statistical significance of the corresponding main effect or interaction in parentheses. The estimates in Table 5 are from analyses that did not take the complex survey design into account, because we are not aware of a validated method for estimating effect sizes for main effects and interactions with complex survey data. Parallel models taking the survey design into account yielded similar parameter estimates and hypothesis test results. For binary measures (marijuana use and drinking), effect size estimates are the exponentiated parameter estimate; for continuous measures (all others), the effect size estimate is the parameter estimate divided by the square root of the model mean squared error.

Overall difference among groups, * $p < .05$; ** $p < .01$; *** $p < .001$.

Significant main effects or interactions, † $p < 0.05$; †† $p < .01$; ††† $p < 0.001$; "n.s." indicates nonsignificant main effects or interactions, $p \geq .05$.