The Validity and Clinical Utility of Night Eating Syndrome

Ruth H. Striegel-Moore, PhD[1]*
Debra L. Franko, PhD[2]
Jennifer Garcia[1]

ABSTRACT

Objective: To review the empirical literature for evidence in support of inclusion of Night Eating Syndrome (NES) in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders.

Method: Based on a literature search using PubMed, 47 empirical studies of NES were identified.

Results: The literature reflects use of varying definitions; progress has been made toward reliable measurement of night eating symptoms; evidence regarding a differentiation of NES from "normalcy" or from other eating disorders is based largely on samples of convenience; only one controlled treatment study has been published.

Discussion: There are limited data supporting the clinical utility and validity of NES; several options regarding the inclusion of NES in DSM-V are discussed. © 2009 American Psychiatric Association.

Keywords: night eating syndrome; validity; clinical utility; DSM; diagnosis

Introduction

Night eating syndrome (NES) was introduced into the scientific literature in 1955 by Stunkard et al.[1] as a food intake pattern of clinical significance among obese individuals. Based on systematic clinical observations of a case series of 23 obese women and 2 obese men who had been referred to a specialty clinic because of "the severity of their obesity or difficulty in its management" (p.78), three core symptoms were described as characteristic of NES: "nocturnal hyperphagia," insomnia, and morning anorexia. The authors describe the three criteria for NES as follows. "First, and of greatest importance, is the consumption of large amounts of food during the evening and night and no one was considered to manifest the syndrome unless he ate at least a quarter of his total calories for the day during the period following the evening meal. Thus, a significant part of the total caloric intake, and a major part of the *excess* intake [emphasis added], occurs during a time when the food intake of nonobese people is negligible. The second criterion is sleeplessness, at least until midnight more than half of the time, and the third is morning anorexia with negligible food intake at breakfast. In no case did this include more than a cup of coffee or a small glass of orange juice" (p. 79). Stunkard et al.[1] noted that this syndrome might fruitfully be explored as one causal model for the development of obesity, a heterogeneous condition seen as having multiple etiologies. Moreover, the authors reported that the presence of NES unfavorably influenced outcome of the treatment program and, indeed, increased risk for severe adverse reactions to treatment including severe, disabling depression or anxiety. This early report proposed that NES represented "a response to stress of a type peculiar to certain obese patients, and one intimately related to the overeating which leads to their obesity" (p. 83). The authors discussed the possibility that the diurnal eating pattern represented a stress-induced alteration in the diurnal rhythm. For decades, this early description of NES received scant attention in the medical scientific community. Similarly, papers by other obesity experts describing the treatment of NES[2] or "the tension night eater"[3] appeared to stimulate little interest in research of the syndrome.

It bears noting that in the early literature, evening hyperphagia was conceptualized in the context of an overall pattern of excess food intake among the obese. The focus of excess eating has yielded in the contemporary literature to an emphasis on phase shifting one's food intake from the (presumably) normative pattern of eating three meals during the day with little food being consumed after the evening meal to a pattern where eating does not begin until mid-day and continues

well into the evening or even into the night. Hence, at present, what is pathological about evening hyperphagia is the *timing* of the food intake, not the overall amount of food consumed. It is implied (and in some studies explicitly stated) that "force of circumstance" needs to be taken into account in assessment: late day or night eating due to work schedules or other circumstances (e.g., regional or cultural differences in timing of evening meal) preventing a person from eating at "normal" times does not count as a symptom.

After a long period of "neglect," a 1999 article on behavioral and neuroendocrine characteristics among individuals with NES[4] invigorated scientific interest and, especially in the past decade, the number of studies has increased substantially. The syndrome is not among the specific eating disorders defined in the Diagnostic and Statistical Manual for Mental Disorders (DSM), nor is it mentioned in the DSM as a specific example of an Eating Disorder not Otherwise Specified (EDNOS).[5] In a recent editorial addressing the ongoing work toward developing the fifth edition of the DSM, Stunkard et al.[6] advocated for a "wider recognition of the disorder," asserting that NES is a source of distress, may represent a pathway to obesity, has construct validity, and can be treated effectively. A more comprehensive review article by Stunkard et al.[7] concludes that "research of NES supports the validity of the diagnosis and its inclusion in DSM-V" (abstract, p. 1 of article). This article examines the scientific evidence and describes options for how NES might be addressed in the DSM-V.

Method

Our article builds on an earlier review entitled "Should night eating syndrome be included in the DSM-V?"[8] and the recent review by Stunkard et al.[7] addressing the same question. Both reviews used the criteria articulated by Blashfield et al.[9] for determining whether scientific evidence supports introduction of a new disorder into a disease classification system, and we begin our assessment of the more recent literature following these guidelines. In brief, the criteria are (1) ample literature (to ensure that the syndrome has been the focus of adequate scholarly attention); (2) a common set of diagnostic criteria; (3) at least two empirical studies by independent research groups demonstrating high inter-clinician agreement when assigning the diagnosis to patients (κ of ≥ 0.70); (4) evidence of syndrome validity; and (5) reliable differentiation of the syndrome from other (similar) syndromes. Because the Blashfield criteria do not directly

address clinical utility, which is a major consideration for diagnoses in DSM-V, the latter sections of this aticle will consider matters related to clinical utility.

To identify relevant articles we searched PubMed using the search terms "night eating disorder" and "nocturnal eating" and we reviewed the reference lists of Striegel-Moore et al.[8] and Stunkard et al.[7] for any articles our PubMed search might have missed. Only empirical articles (and not individual case reports, commentaries, or review articles) were included in this review.

Results

Ample Literature

This criterion serves as an initial assurance that the proposed syndrome has attracted scholarly attention and calls for at least 50 journal articles, 25 of which should describe empirical studies. For the present review, we found 43 empirical studies that either focused specifically on NES or described studies of meal patterning with information on eating during the night; we therefore conclude that the requirement for at least 25 empirical studies undoubtedly has been met. In addition, NES has been the subject of at least 15 review articles as well as numerous short commentaries or clinical case descriptions.

Consistent Definitions of Night Eating Syndrome

Striegel-Moore et al.[8] provided a detailed table listing definitions of NES in studies published until 2004. They arrived at three overall conclusions. One, most studies defined NES as involving the presence of evening hyperphagia (a term that replaced the earlier "nocturnal hyperphagia"), insomnia and morning anorexia, the three features included in the 1955 definition proposed by Stunkard et al.[1] Hence, there was considerable *consistency* in the general sense of what symptoms ought to be considered when determining the presence of NES. However, there were marked *inconsistencies* in the operationalization of each of the three core symptoms. For example, the cut-points for defining evening hyperphagia varied in terms of the proportion of daily caloric intake (from a low of 25% to a high of 50%) and the time frame used for considering the calories as having been consumed "late" in the day ("after the evening meal" versus a specific time, typically after 7 pm). Finally, there was a near uniform lack of frequency or duration criteria, even though Birketvedt et al. in 1999 had introduced a criterion set that included a minimum duration

requirement of 3 months for the core symptoms.[4] Consequently, study samples have varied along the dimensions of severity and chronicity of NES.

Striegel-Moore et al.[8] recommended the development of more clear definitions of the core symptoms and specification of frequency and duration criteria modeled after those used for bulimia nervosa. Overall, echoing the findings of a slightly earlier review[10] they concluded that the criterion of consistency of definition had not yet been met. Also published in 2006, a review by Colles and Dixon[11] noted that "within the literature, variable NES definitions highlight the distinct lack of clarity as to which behavioral features constitute a clinically meaningful entity" (p. 811). These observations have been reiterated in subsequent reviews.[12,13]

For the purpose of the present review, we examined definitions of NES that have been used in the empirical literature since the introduction of the detailed NES definition by Birketvedt et al.[4] We located 29 articles published after 2000 that focused on a description of NES or its correlates, course or outcome, or response to treatment trials.[14–42]

Table 1 provides the definitions used in this literature. Not shown in **Table 1** (but discussed later in this review) are studies that focused solely on single symptoms (e.g., nocturnal eating) and did not purport to study the syndrome of NES.[43–50] Listed in the **Table 1** are the inclusion criteria (i.e., features that have to be present) and exclusion criteria used for assigning a diagnosis of NES. The table columns are organized to permit coding along the NES definition introduced by Birketvedt et al.[4] (shown in the first row) which represents the most detailed criterion set specified in the literature (each of the five columns would need to be answered affirmatively for an NES diagnosis). We first describe definitions of each of the core features (i.e., morning anorexia, evening hyperphagia, nocturnal eating, and insomnia), followed by a discussion of how these core features are combined for defining the syndrome.

Before answering the question of whether the field has moved closer to using a consistent definition of NES, we need to note that the articles coded in **Table 1** do not represent 29 unique studies with distinct study populations. Rather, several studies involve subsets of participants drawn from the same participant pool and the application of the same criterion set therefore should be expected.

Morning Anorexia. Seventeen studies used definitions that included morning anorexia as a core symptom and 10 articles (all representing work of Stunkard's group) reported on samples whose diagnosis of NES did not require lack of appetite or breakfast skipping. When "morning anorexia" was required for the diagnosis of NES, in all but two studies no frequency threshold was provided. Colles et al.[40] specified that the symptom should be "usually" present; Gluck et al.[16] required skipping breakfast at least on 4 days of the week.

Of note, several studies provided data suggestive of the limited utility of this item. In a study using Ecological Momentary Assessment (EMA), Boseck et al.[35] found no support for morning anorexia among a small group ($N = 14$) of self-identified individuals with night eating behavior. Rather, hunger ratings were highest in the morning and during the nocturnal eating episodes. It is unclear from the report of this study whether these individuals did eat in response to their morning hunger. In a sample of 81 individuals with evening hyperphagia and/or nocturnal eating episodes, scores on a single-item measure of morning hunger did not correlate significantly with the total score on the Night Eating Questionnaire (NEQ) or the NEQ Evening Hyperphagia subscale and correlated only modestly ($r = 0.25$) with the NEQ Nocturnal Eating subscale.[38] The authors concluded that morning anorexia is not a "significantly informative diagnostic symptom of NES" (p. 69). This conclusion was further supported by a re-analysis of NEQ data collected as part of six separate studies that included a combined total of 1,481 participants (including 34.5% with evening hyperphagia and/or nocturnal eating), using Item Response Theory analysis.[51]

In conclusion, the operationalization of "morning anorexia" varies across studies and some NES experts recently have concluded that "morning anorexia" is not central to the definition of the syndrome.

Evening Hyperphagia. Evening hyperphagia typically is defined by an algorithm requiring the determination of the timing of the intake ("evening") as well as the proportion of daily caloric intake consumed (the "hyper" of hyperphagia). A majority of studies required at least 50% of daily intake to be consumed late (by a specific time or after the evening meal). Nine studies set a less restrictive threshold for the amount of food consumed (25% or more) and "pegged" this intake to "after the evening meal." In some cases the criterion of hyperphagia was changed across studies from the same research lab, though the rationale for doing so was not provided. For example, the most commonly used definition of evening hyperphagia in studies from Stunkard's group involved consumption of 25% or more of the daily caloric intake after the evening

TABLE 1. Symptoms (and symptom definitions) used for classifying study participants as meeting criteria for night eating syndrome (NES) in empirical reports published since the introduction of the Birketvedt criteria

Study	Morning Anorexia	Evening Hyperphagia	Nocturnal Awakening with Eating	Sleep Disturbance	Duration	Exclude EDs?
Birketvedt et al.[4]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after the last evening meal	(and) Consumption of snacks during the awakenings ≥1 times/night	Awakenings ≥1 times/night	≥3 months	BN, BED[a]
Aronoff et al.[14]	Morning anorexia or negligible intake in the morning	Eating ≥50% of daily caloric intake after 7 p.m.		Insomnia >3 times/week		
Ceru-Bjork et al.[15]	No appetite in the morning	The largest daily food intake occurs after 7 p.m.		Trouble getting to/or staying asleep		
Gluck et al.[16]	Skipping breakfast ≥4 days/week	Eating >50% of daily caloric intake after 7 p.m.		Trouble getting to/or staying asleep ≥4 days/week		
Napolitano et al.[17]	Lack of appetite in the morning	Eating ≥50% of daily caloric intake after 7 p.m.				
Adami et al.[18]	No appetite in the morning	Eating >25% of daily total caloric intake after the evening meal		Trouble getting to/or staying asleep most nights		
Birketvedt et al.[19]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after the last evening meal	(and) Consumption of snacks during the awakenings ≥1 times/night	Awakenings ≥1 times/night	≥3 months	BN, BED[a]
Pawlow et al.[20]	Morning anorexia	Eating ≥50% of daily caloric intake after 6 p.m.		Insomnia		[b]
Marshall et al.[21]	No details provided (NDP)	(NDP)	(NDP)	(NDP)	(NDP)	(NDP)
O'Reardon et al.[22]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after the last evening meal	(and/or) Consumption of snacks during the awakenings ≥1 times/night	Awakenings ≥1 times/night	≥3 months	BN, BED[c]
O'Reardon et al.[23]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after the last evening meal	(and/or) Consumption of snacks during the awakenings ≥1 times/night	Awakenings ≥1 times/night	≥3 months	BN, BED[d]
Allison et al.[24]	Morning anorexia even if the person eats breakfast	Eating about 50% of daily caloric intake after the evening meal	(and) Awakenings to eat ≥3 times/week	Awakenings ≥1 times/night	≥3 months	All other EDs
Allison et al.[25]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) Awakenings to eat ≥3 times/week			
Allison et al.[26]		Eating >25% of daily caloric intake after the evening meal	(or) Awakenings to eat ≥3 times/week			
Lundgren et al.[27]		Eating ≥25% of daily caloric intake after evening meal	(or) awakenings to eat ≥3 times/week			
Lundgren et al.[28]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/week		≥3 months	
Friedman et al.[29]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after the last meal	(and) awakenings to eat ≥1 times/night	awakenings ≥1 times/night	≥3 months	BN, BED
O'Reardon et al.[30]	Morning anorexia even if the person eats breakfast	Eating ≥50% of daily caloric intake after 8 p.m. (after 8 p.m.)	(and) awakenings to eat ≥3 times/week	Awakenings ≥1 times/night	≥3 months	All other EDs[e]

TABLE 1. *(Continued)*

Study	Morning Anorexia	Evening Hyperphagia	Nocturnal Awakening with Eating	Sleep Disturbance	Duration	Exclude EDs?
Rogers et al.[31]	Morning anorexia even if the person eats breakfast	Eating ≥35% of daily caloric intake after 8 p.m.	(and) awakenings to eat ≥3 times/week	Awakenings ≥1 times/night		All other EDs
Stunkard et al.[32]		Evening hyperphagia	(and/or) insomnia with food ingestions on awakening			
Allison et al.[33]		Eating ≥25% of the daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/night			
Allison et al.[34]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/week			
Boseck et al.[35]		Eating ≥50% of daily caloric intake after the last evening meal ≥2 times/week	(and/or) awakenings to eat ≥2 times/week			All other EDs
Colles et al.[36]	No appetite for breakfast	Usually eating ≥50% of daily caloric intake after 7 p.m.		Trouble getting to/or staying asleep ≥3/nights	≥3 months	
Jarosz et al.[37]	Score ≥ 30 on NESQ	Score ≥30 on NESQ	Score ≥ 30 on NESQ	Score ≥ 30 on NESQ		BN
Allison et al.[38]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/week			
Boston et al.[39]	Morning anorexia even if the person eats breakfast	Eating >50% of daily caloric intake after 8 p.m.	(and) awakenings to eat ≥3 times/week	Awakenings ≥1 times/night	≥3 months	All other EDs
Colles et al.[40]	No appetite for breakfast	Usually eating ≥50% of daily caloric intake after 7 p.m.		Trouble getting to/or staying asleep ≥3/nights	≥3 months	
Lundgren et al.[41]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/week			AN, BN[f]
Lundgren et al.[42]		Eating ≥25% of daily caloric intake after the evening meal	(and/or) awakenings to eat ≥3 times/week		≥3 months	All other EDs[g]

Notes: ED = Eating Disorder; AN = Anorexia Nervosa; BN = Bulimia Nervosa; BED = Binge Eating Disorder.

An empty (or blank) table cell indicates the symptom in question is not included among the criteria required for an NES diagnosis in a given study. Implied or explicitly stated in these studies is the exclusion criterion of working at night. Additional exclusion criteria for participation in the study are noted as follows.

a Serious physical or emotional illness, including diabetes mellitus and other endocrine disorders; use of psychotropic medications, steroids, diuretics, or hypnotics; excessive consumption of alcohol; participation in a weight reduction program.

b Serious physical or emotional illness; pregnancy; use of steroids; participation in a weight reduction program.

c Any other Axis I diagnosis; substance abuse or dependence within the preceding 6 months; diabetes mellitus; currently taking psychotropic medications (including hypnotics); currently in a weight reduction program.

d Lifetime diagnosis of bipolar disorder or any psychotic disorder; substance abuse, or dependence within the preceding 6 months; currently taking psychotropic medications (including hypnotics); currently in a weight reduction program.

e Severe depression (symptoms in excess of the number required for DSM-IV diagnosis and markedly interfering with occupational functioning or usual social activities or relationships); lifetime diagnosis of bipolar disorder or any psychotic disorder; substance abuse, or dependence within the preceding 6 months; currently taking psychotropic medications (including hypnotics); currently in a weight reduction program.

f Psychotic disorder; bipolar disorder; substance use disorder within the past 3 months; severe current depression; diabetes; sleep apnea; currently in a weight reduction program; pregnancy.

g Bipolar disorder; current substance use disorder; diabetes; sleep apnea; use of psychotropic medications during the past 8 weeks; currently in a weight reduction program; any active medical condition that could affect cerebral functioning.

meal; however, one study employed a 35% or greater caloric intake cut-point,[31] and five of the studies set a more restrictive criterion of 50% or more of daily caloric intake.[22–24,30,39] Three of these studies from Stunkard's group specified that this intake had to occur after the evening meal; and two studies used 8 pm as the time after which consumption counted toward "evening hyperphagia."

Ten of the studies shown in **Table 1** specified a time threshold of 6 p.m., 7 p.m., or 8 p.m. We could not find a study that systematically varied the criterion among these three times but it is likely that even the relatively minor time difference of 1 or 2 hours (6 p.m. vs. 7 p.m. or 8 p.m.) would result in considerably different prevalence rates for evening hyperphagia. Experts from European countries have noted that timing of the evening meal is subject to considerable cultural variation and have advocated, therefore, for using the last evening meal as the threshold.[4,52] As discussed in detail by Striegel-Moore et al.[48,50] using a threshold based on time of day (e.g., 7 p.m.) versus a threshold based on the evening meal leads to widely varying prevalence estimates. For example, based on food diaries collected in a community sample of 18-year-old girls, 44.1% consumed at least 25% of their daily intake after 7 p.m.; only 17.5% of the sample met the threshold when it was defined a consuming at least 25% of their daily intake after dinner.[50]

The second element of the evening hyperphagia definition, namely the proportion of daily caloric intake consumed, has been defined using varying cut-points from the relatively inclusive (at least 25%) to the highly restrictive (at least 50%). Using food diaries of nationally representative adults in the United States, Striegel-Moore et al. found that the prevalence of "evening hyperphagia" was more than cut in half when using the more restrictive threshold.[48] The most restrictive definition of evening hyperphagia specifies both a high proportion of daily intake (50% or more) and requires that the consumption occur "after the evening meal." In the aforementioned study of 18-year-old girls, only 1.6% of girls consumed at least 50% of their daily caloric intake after dinner.[50]

In the studies summarized in **Table 1**, presence of evening hyperphagia was determined either by questionnaire self-report ("How much of your daily intake do you consume after suppertime?") or by examination of 7-day food diaries. With one exception,[35] the frequency of evening hyperphagia was not specified; rather, it was considered present when it represented the "usual" or "typical" pattern. When 7-day food diaries were used, it was

unclear whether presence of evening hyperphagia was based on a 7-day average or whether evening hyperphagia had to be present on all or a majority of days.

In conclusion, there is considerable variability in the operationalization of evening hyperphagia, the core feature of NES. We could not find any studies that tested different thresholds against a clinically meaningful validator. Given considerable demographic and cultural variations in timing of the evening meal,[48,52] the question remains as to where the threshold should be set for defining this core feature of NES.

Nocturnal Eating. With few exceptions, current studies employ an expanded definition of evening hyperphagia that includes "nocturnal eating episodes." This is a departure from the pre-2000 definitions of NES that did not involve nocturnal eating as a defining feature. Nocturnal eating episodes are defined as awakening during the night and consuming food before returning to sleep. Nocturnal eating has been noted in the clinical literature as a feature of some sleep disorders where it typically has been defined as uncontrollable eating without awareness.[53] In contrast, when being considered as a symptom of NES, awareness of these nocturnal eating episodes is required.

Five studies required presence of both evening hyperphagia *and* nocturnal eating and ten studies used an "and/or" algorithm. When both symptoms were required, nocturnal eating had to be present literally every night according to Birketvedt et al.,[4] but some studies relaxed this criterion to a minimum of three nights/week. Studies using an "and/or" algorithm required this feature to be present on at least three of seven nights.

Potentially, this combination criterion of evening hyperphagia and/or nocturnal eating introduces new heterogeneity in the study samples, as some participants may eat a large proportion of their calories late in the day or into the night without any episodes of nocturnal eating while others may exclusively experience nocturnal eating episodes.

Some studies suggest considerable co-occurrence of nocturnal eating and evening hyperphagia, although specific estimates are not always reported. For example, in 106 individuals recruited specifically for a study of people who eat large amounts of food in the evening or wake up to eat at night, only 10 participants did not report *any* nocturnal eating and 57.5% reported that they often or always got up at night to eat.[54] Other studies found that a considerable subset of participants reported only one but not the other symptom. For example,

among 215 bariatric surgery candidates, 49 (23.7%) self-reported evening hyperphagia only, 15 (7.2%) self-reported nocturnal eating only, and only 8 (3.9%) self-reported both behaviors.[26]

The literature is mixed as to whether nocturnal eating is the core symptom, whether evening hyperphagia can serve as an alternate symptom, or whether both are necessary for NES. It is furthermore unclear whether evening hyperphagia and nocturnal eating are equivalent relative to some clinically meaningful indicator. The impact of this change on the heterogeneity of study samples is unknown.

Nocturnal eating has been examined in Sweden,[15] Australia,[36] Germany,[46] New Zealand,[55] the US,[56] and Denmark.[57] These studies have found widely varying rates of nocturnal eating (from 3.8% in a community sample[36] to 55% in a bariatric surgery sample).[55] This variability is likely due to differences in sampling, means of assessment, and sample size. Moreover, nocturnal eating was found to be associated with depression and quality of life in some studies[36,46] but *not* in a study of BED individuals who reported night eating,[56] again highlighting the mix of findings associated with this symptom.

Insomnia. While studies published before 2000 almost universally had employed the three-part criterion of evening hyperphagia, morning anorexia, and insomnia,[8] in the current literature this symptom was no longer are required for a diagnosis in 13 studies. Operationalization of insomnia varied among studies that did require this symptom. Birketvedt et al.[4] focused on nocturnal awakenings which, by definition, are necessary for nocturnal eating to occur. In other studies, either difficulty falling asleep or staying asleep were sufficient for meeting this criterion.

Results of item response theory analysis of NEQ data representing 507 individuals with evening hyperphagia or nocturnal eating and 972 individuals without these symptoms suggested that difficulty falling asleep ("about half the time") and nocturnal awakenings for reasons other than to go to the bathroom ("more than once a week") contributed significantly to discriminating between the two groups, leading the authors to recommend that these two sleep-related symptoms should be included among the core symptoms required for a diagnosis of NES.[51]

In conclusion, in a majority of studies, NES definitions included insomnia among the core symptoms and, in turn, this symptom was defined in some but not all studies using a frequency threshold.

Exclusion Criteria. When NES first was introduced, the only eating disorder recognized was anorexia nervosa. Given that NES was described as a clinical syndrome affecting obese individuals, explicitly noting presence of an eating disorder as an exclusion criterion was not necessary. As the definition evolved, it was stressed that NES represented a distinct disorder not best characterized by existing diagnoses of sleep disorders or eating disorders, but only eating disorders (and not sleep disorders) have been mentioned explicitly as exclusions in the definitions found in the studies of the past ten years. As shown in **Table 1**, twelve studies used presence of an eating disorder (bulimia nervosa or binge eating disorder, BED) as an exclusion criterion. Although the diagnostic criteria for NES are silent on body weight, given the fact that almost all studies recruited overweight or obese individuals, de facto, individuals with anorexia nervosa were excluded from research. We noted that in some of the studies it was not clear whether individuals with an eating disorder were excluded because of the particular NES *definition* employed by the authors or whether such individuals were excluded because of the particular *study aims*. For example, several studies listed eating disorders when describing a more comprehensive set of disorders that made individuals ineligible for inclusion in the study. This set typically included psychosis, bipolar disorder, severe depression, substance use disorder, and conditions known to affect eating and sleep.

In conclusion, exclusion criteria have not yet been articulated consistently in the literature. The variations in exclusion criteria, along with the practice to exclude such individuals from research in some but not all studies likely influenced comparability of findings across studies. It also likely influenced findings concerning the clinical significance of NES or its symptoms (which will be considered later in this article).

Syndrome versus Symptom?

Variations in terms of the specific definitions of the core NES symptoms aside, it appears that in the past decade two types of definitions have been used for a diagnosis of NES. One involves the set of five inclusion criteria combined with one exclusion criterion described by Birketvedt et al.[4] The second type of NES definition does not require morning anorexia or insomnia and, by virtue of employing an "or" algorithm, basically involves one symptom domain: evening hyperphagia and/or nocturnal eating. Colles et al.[36] refer to this

symptom as "a time-delayed pattern of eating relative to sleep," where most food is consumed late in the day and into the evening and night. Definitions requiring the presence of only this single symptom domain (i.e., evening hyperphagia and/or nocturnal eating) use a less restrictive cut-point when defining evening hyperphagia (at least 25% of daily caloric intake after the evening meal) than many of the studies where the diagnosis is based on multiple symptoms. Hence, the NES syndrome definition is setting a much more restrictive threshold overall (i.e., by requiring the presence of multiple symptoms) and also in regards to the symptom of evening hyperphagia (by requiring intake of only 25% rather than 50% late in the day).

We could not find any studies that compared individuals who fulfilled NES *syndrome* criteria versus individuals meeting the less restrictive NES *symptom* criterion requiring the presence of evening hyperphagia and/or nocturnal eating. However, one study provided data illustrating how varying the definition of NES affected estimates of the prevalence of the syndrome. Specifically, a study that recruited individuals who "eat large amounts of food in the evenings" and/or "get up at night to eat" found that, not surprisingly, far fewer participants (13.2%) met the Birketvedt et al.[4] NES syndrome criteria than the symptom criterion of eating at least 25% of daily intake after the evening meal (76.4%) or 50% of daily intake after the evening meal (45.3%), or reporting nocturnal eating usually or always (57.5%).[54]

Overall Conclusion. Two different types of NES definitions have been used in the past decade: a *syndrome* definition and one that is basically a *symptom* definition. Both definitions center on the notion that the core disturbance lies in the temporal patterning of eating rather than the amount or type of food consumed or the person's attitudes about or subjective experience of eating. Stunkard et al.[7] concluded that the field now has reached consensus that evening hyperphagia ("consumption of at least 25% of daily intake after the evening meal") and two or more "nocturnal awakenings with ingestions per week" represent the core diagnostic criteria for NES. However, a recently proposed "working" definition (intended to stimulate research both of the specific symptoms listed as well as their possible combination into a clinical syndrome) at a 2008 meeting of experts interested in night eating enumerates a far more comprehensive set of criteria. Thus, there now is opportunity to generate more consistent data about NES and empirical support for the newly included criteria

(e.g., lower mood in the evening; overwhelming urge to eat).

Diagnostic Reliability and Assessment of NES

The diagnostic reliability criterion requires that there be at least two empirical studies by independent research groups where interclinician agreement levels have κ values of 0.70 or better.[9] At issue is whether, when presented in their daily practice with a person experiencing a disorder, different clinicians would arrive at the same diagnostic judgment when applying the diagnostic criteria for the given disorder. The focus here is on whether the set of criteria is formulated in such a way (e.g., clear and unambiguous, simple) as to optimize the likelihood of agreement between clinicians. In eating disorders, there is an extensive research literature focusing on the reliability of assessment instruments[58] and reliability has been established using trained research staff rather than clinicians; in contrast, studies of the reliability of the diagnostic criteria per se are uncommon.[59] To answer the question of diagnostic reliability of NES, we searched for studies using either approach.

Interclinician Reliability. Of the 27 studies reviewed, only one study reported inter-rater reliability.[17] Specifically, using a random sample of 17 participants (selected from a total of 83), independent judges rated interview responses to two questions used for making a diagnosis of NES. κ coefficients were 0.76 for the diagnosis, 0.76 for morning anorexia ("Do you typically lack appetite in the morning?"), and 0.88 for evening hyperphagia ("Do you often eat most of your calories, i.e., 50% or greater, in the evening, after 7 p.m.?").

Reliability of Assessment Instruments. A 14-item self-report questionnaire, the *Night Eating Questionnaire* (NEQ), has been developed and modified a number of times since its initial use.[38] Instrument development has focused on internal reliability and validity of the NEQ. Notably absent from this literature are efforts to establish test–retest reliability of the NEQ. The NEQ has been used as a screening questionnaire using a total score for identifying possible NES cases. The authors reported an analysis of Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of the NEQ (for two NEQ cut-points: 25 or 30) in a sample of bariatric surgery patients, using the "symptom definition" of NES. The findings are difficult to interpret because it appears that when determining the operating characteristics of the NEQ, only people who "reported symptoms of night eating" were interviewed (rather than also individuals who screened negatively) and the authors provide little informa-

tion as to how they arrived at their findings. The PPV was 40.7% or 72.7% for a cut-point of 25 or 30, respectively; NPV was high for either cut-point (95.2% and 94%, respectively). It is unclear how the NEQ performs in regards to making the syndrome diagnosis of NES.

Syndrome Validity: Coherence of Core Symptoms

Blashfield et al.[9] fourth criterion requires at least two independent empirical studies confirming that if a patient exhibits one diagnostic symptom the same patient will have at least a .50 probability that s/he will exhibit another symptom of the disorder. No study specifically examined this research question, although one study is instructive. In a sample of 106 individuals who were recruited for a study of people who experience evening hyperphagia or nocturnal eating, 76.4% reported eating at least 25% of their daily intake after the last evening meal and 75.5% reported little or no hunger in the morning.[54] Although the authors only reported the prevalence estimates for the entire sample and did not calculate specifically for each symptom the probability of co-occurrence, at least for morning anorexia and evening hyperphagia this study provided evidence that the same patient with one symptom would have at least a 50% chance of also reporting the other symptom. We were unable to find a second study that examined this question.

Can NES be Distinguished from Normalcy and from Other Disorders?

In addition to requiring coherence of core symptoms, when discussing evidence for syndrome validity Blashfield et al.[9] focus on the question of whether the proposed syndrome meaningfully can be differentiated from other disorders. As noted by Kendell,[60] syndrome validity is further enhanced by evidence of boundaries or points of rarity and evidence of distinct etiological processes. Given the intended use of the DSM-V as a tool to facilitate clinical care of patients, we also focused on prevalence (i.e., how likely is it that clinicians are encountering this problem) and clinical significance (i.e., degree of suffering or impairment) as well as predictive validity of syndromes with regard to course, outcome, and treatment response. Notably, different indicators of syndrome validity do not always agree.[60]

We examined the scientific knowledge base regarding the various forms of syndrome validity and found no studies that would permit an assessment of points of rarity (e.g., taxometric analyses). **Table 2** summarizes the key methodological details

and findings of studies addressing prevalence, clinical significance, and correlates of NES; **Table 3** summarizes studies of the comorbidity between NES and other eating disorders; and **Table 4** describes studies examining course and treatment outcome. As these tables illustrate, several methodological limitations (beyond the already described problems in definition and measurement of NES) characterize this literature. The most common *recruitment strategy* (used in 18 studies) has been to place advertisements inviting individuals who experience evening hyperphagia or nocturnal eating or wish to enter a treatment trial for such problems to contact the research office or enter information on a project web site. This strategy yielded the largest study samples, but because of the targeted recruitment of people with night eating symptoms this approach is not suitable for drawing conclusions about prevalence of NES. The second most common approach to finding study participants has been to recruit consecutive patients seen at specialty treatment centers for obesity (nine studies; of these, three studies are based on bariatric surgery candidate samples). Given the well-established phenomenon that treatment seeking individuals tend to report more health and mental health problems than community-based populations, patient recruitment likely leads to inflated estimates both of the prevalence of NES as well as the prevalence of comorbid disorders or functional impairment. Generalizability of study findings is further reduced when investigators systematically exclude participants based on certain clinical features (e.g., severe psychopathology; use of psychotropic medications), as was done in a number of studies. Notably lacking are epidemiological studies of NES and its core symptoms.

The challenges inherent in trying to define or recruit appropriate *control participants* have not yet been discussed in this literature. In the case of studies where samples are recruited via advertisements for study volunteers comprised of individuals who do versus do not experience night eating symptoms, it is possible that participants differ in their motivations for participation in ways that bias the results. Moreover, when matching controls to NES cases on variables such as demographic or weight characteristics (which is clearly appropriate when these variables are expected to be confounders), the reader is reminded that it is not possible then to draw conclusions about these variables as correlates of or risk factors for NES.

Sample sizes of individuals with NES tend to be quite small, with 14 studies including 20 or fewer NES cases. Few of the studies reported *effect size*

TABLE 2. Studies of prevalence and/or correlates of NES

Study	NES Sample	Comparison Sample	Recruitment	Assessment for NES Diagnosis	NES Prevalence (of Total Sample)	Correlate Findings[a]
Aronoff[14]	23 Women, 33 men	Obese: 45 women, 9 men	110 consecutive obese outpatients (mean age 48 ± 13; mean BMI 55 ± 14)	Clinical interview	51%	Gender: NES more likely to be male. Age: n.s. BMI: NES > obese
Ceru-Bjork[15]	9 Women, 2 men	Obese: 124 women, 43 men	194 consecutive out-patients at obesity clinic (mean age 44 ± 12; mean BMI 44 ± 5)	"Eating + sleep questionnaire"	5.7%	Age, gender, marital status, employment status, smoking status, long term sick leave, morning anorexia, BMI,: n.s.
Gluck[16]	8 Women, 3 men	Obese: 45 women, 20 men	76 obese outpatients (mean age 43.5 ± 9.5; mean BMI 31.7 ± 6.5)	Questionnaire developed for the study	14.5%	Age, BMI: n.s. Hunger before morning test meal, self-esteem, weight loss: NES < Obese. Depression: NES > Obese
Napolitano[17]	18 Women, 18 men (of these, 23 "NES only")	BED: 23 women, 3 men (of these, 13 with NES); obese: 23 women, 24 men	83 obese inpatients (mean age 48.1, range 18-74; mean BMI 41.1, range 22.6–77.2)	Clinical Interview	43%	Gender, BMI, trait anxiety, self-esteem, depression, cognitive restraint, hunger recognition, eating self-efficacy: n.s. Age: "NES only" < no ED state anxiety, behavioral disinhibition: "NES only" < NES + BED (age adjusted)
Adami[18]	18 Women, 8 men	BED: 33 women, 8 men; obese: 79 women, 20 men	166 consecutive patients at a hospital based weight loss program (mean age not reported; mean BMI 43.5, SD = 9.9)	Clinical Interview	15.7%	Gender, BMI, resting energy index, cognitive restraint: n.s. with "NES only" reported less hunger and lower disinhibition than those with BED or BED + NES
Allison[26]	19 (Gender not reported)	BED: 9 N: 1 no NES/ED: 181	210 (172 women, 38 men) consecutive bariatric surgery candidates (mean age 44.4, SD 10.7; mean BMI 50.4, SD = 8.1)	Clinical Interview	8.9%	Gender, ethnicity, BMI, smoking history, sleep apnea, age of overweight/obesity onset, psychiatric medication: n.s.

TABLE 2. *(Continued)*

Study	NES Sample	Comparison Sample	Recruitment	Assessment for NES Diagnosis	NES Prevalence (of Total Sample)	Correlate Findings[a]
Lundgren[27]	30 Women, 19 men	253 psychiatric patients	399 (61.4% female) patients recruited at psychiatric clinics following "physician approval" (mean age 40.8, SD = 12.7; mean BMI 29.1, SD = 7.5)	NEQ/NESHI	12.3% (or 15.6% if deleting non-respondents from base)	Age, ethnicity: n.s. BMI: NES > psychiatric controls lifetime substance use disorder or use of atypical antipsychotic medication (based on chart review): NES (30.6%) > psychiatric controls (8.3%)
Friedman[29]	2 Women, 1 man	45 women, 14 men with SAD	62 consecutive sleep clinic outpatients with Seasonal Affective Disorder (SAD) (mean age 41.9, SD = 11.5, mean BMI 23.9, SD = 4.7)	Clinical Interview and 3-day food records	4.4%	Age: NES > SAD
Allison[33]	32 (of these 29 "NES only")	BED: 9, overweight: 834 (for some variables n = 500)	845 (60% women) participants in the LOOK AHEAD weight loss trial for overweight people with Type 2 diabetes (mean age 59.9, SD = 6.9, mean BMI 36.4, SD = 6.2)	NEQ /NESHI	3.8%	Gender, age, BMI, blood pressure, metabolic measures: comparisons not reported for NES versus BED or overweight; weight concern, shape concern, total EDE-Q score, depression: NES > overweight
Colles[36]	34 Women, 14 men	18 women, 11 men non-NES controls matched on gender, age, BMI	180 bariatric surgery candidates (mean age 44.8, SD = 11.2, mean BMI 44.5, SD = 6.8); 93 members of a weight-loss support group (mean age 55.1, SD = 12.4, mean BMI 32.7, SD = 73), 158 community responders to public notices for non-weight loss seekers (mean age 41.3, SD = 13.5, mean BMI 24.8, SD = 5.1)	Clinical interview	surgery candidates: 19.4%, weight loss: 4.3%, community: 5.7%	NES correlated with BMI. NES only" versus controls: n.s. on depression, hunger, restraint, disinhibition, appearance dissatisfaction, weight/shape concerns, mental health-related quality of life

TABLE 2. *(Continued)*

Study	NES Sample	Comparison Sample	Recruitment	Assessment for NES Diagnosis	NES Prevalence (of Total Sample)	Correlate Findings[a]
Jarosz[37]	16 Women	Obese: 61	96 female patients referred by health professionals to a weight loss program (mean age 40.6, SD = 10.8, mean BMI 40.9, SD = 7.1)	NESQ	18.2%	NES vs. obese: No differences in age, BMI

Notes: NESQ = Night Eating Questionnaire[61]; NESHI = Night Eating Syndrome History and Questionnaire (unpublished).
Findings regarding comorbidity between NES and eating disorders are reported in Table 3. Some studies differentiate between "NES only" (i.e, the subset of NES patients without comorbid BED) and NES + BED when examining correlates of NES in recognition of the possibility that differences between NES and non-NES individuals may, in part or entirely, reflect differences between BED and non-BED.

estimates, even though in some studies the small sample sizes may have made it difficult to detect clinically meaningful effects; on the other hand, in some studies, calculations of numerous comparisons may have contributed to inflated α error. Several studies utilized the same or overlapping study samples and, therefore, the total number of individuals with a diagnosis of NES that have been studied is less than the total sum of participants listed in these tables.

Prevalence and Demographic Correlates of NES. As one would expect in a literature based largely on samples of convenience and using varying definitions and assessment approaches,[38,61–65] prevalence estimates vary widely (see **Table 2**). Several studies offer prevalence estimates in samples of obese patients and suggest that NES is widely prevalent in this population. Estimates are especially high in tertiary treatment centers offering inpatient treatment[17,52] or bariatric surgery.[26,36] A rigorous study of individuals with Type 2 diabetes found that NES was also widely prevalent in this population. Specifically, among 845 participants of the LOOK AHEAD study (which tested the efficacy of a weight loss program) reported that 8.4% met the broad NES criteria requiring presence of either evening hyperphagia or nocturnal eating.[33] The lack of data regarding the prevalence of NES based on commonly accepted epidemiological methods seriously limits our ability to answer the question of how many individuals are affected by this syndrome or whether risk varies by demographic indicators. Also lacking are studies of patients presenting in primary care or for psychiatric services that would help address the question of how commonly NES would be encountered by clinicians in routine practice.

Studies of Clinical Correlates of and Potential Risk Factors for NES. Several studies have compared individuals with NES and individuals who do not have an eating disorder, and findings suggest that individuals with NES differ from individuals without an eating disorder on a number of indicators, although the findings do not replicate across studies or are based on single studies and need to be replicated in independent samples.

Frequently, reviews note that obesity or (in studies of obese populations) higher BMI is a common clinical correlate of NES and indicator of the clinical significance of the syndrome.[7] Most studies have recruited severely obese samples (**Table 2**). However, evidence of differences in BMI between NES and non-NES samples is mixed. In studies comparing NES with non-NES obese participants, BMI was greater in the NES in only one

TABLE 3.   Comorbidity of night eating syndrome (NES) and Bulimia nervosa (BN) or binge eating disorder (BED)

Study	Study Sample	Instrument Used for Diagnosis of NES	Instrument Used for Diagnosis of BED	% BED in NES (% BN in NES)	% NES in BED (% NES in BN)
Lundgren et al.[27]	103 NES patients[a]	NESHI	EDE	19.4%	DNA
Grilo and Masheb[56]	207 Outpatients with BED[b]	EDE[c]	EDE	DNA	9.2%
Napolitano et al.[17]	83 Obese outpatients	Clinical interview	IDED-IV	36%	50%
Adami et al.[18]	166 Obese outpatients	Clinical interview	Clinical interview	50%	24.1%
Jarosz et al.[37]	96 Obese outpatients (all African American)	NESQ	QEWP-R	6.3% (6.3%)	33% (33%)
Allison et al.[33]	845 Overweight patients with Type 2 diabetes	NESHI	EDE	60%	75%
Colles et al.[36]	431 Individuals, including 158 obese community members, 93 obese support group members, 180 bariatric surgery candidates	Clinical interview	Clinical interview	40%	37%
Allison et al.[26]	216 Bariatric surgery candidates	Clinical interview	Clinical interview	26%	41.7%

Notes: DNA = does not apply; EDE= Eating Disorder Examination[62]; IDED-IV= Interview for Diagnosing Eating Disorders, 4th edition[63]; NESQ = Weight and Lifestyle: Night Eating Syndrome Questionnaire[61]; NESHI = Night Eating Syndrome History and Inventory, unpublished; QEWP-R = Questionnaire on Eating and Weight Patterns.[64]   [a] Excluded individuals currently on psychotropic medication, or individuals currently enrolled in a weight loss program.

[b] Excluded individuals currently in other psychosocial treatments, individuals with medical conditions affecting weight (e.g., diabetes), and individuals with severe psychiatric comorbidities including psychosis, bipolar disorder, acute suicidality, and current substance dependence.

[c] Only nocturnal eating was assessed; for the purposes of this table NES was considered present consistent with the "symptom" definition of NES requiring at least three nocturnal eating episodes/week.

study.[14] BMI was not found to be significantly different between NES and non-NES obese participants in the remaining studies where this was reported.[15–18,26,37] In a study comparing NES with a psychiatric control group, BMI was higher in the NES group[27]; however, this may have been due in part to recruitment bias. When compared with a BED group, BMI was not found to differ between NES and BED in either a diabetic sample[33] or a sample recruited by advertisement.[34] Colles et al.[36] reported that NES correlated with BMI in a sample of bariatric surgery candidates.

In these studies, depressive symptoms and diagnosis have generally been more frequent in the NES group.[4,16,24] In a descriptive study of NES, de Zwaan et al.[54] found that 56% had a lifetime history of major depressive disorder, likely higher than healthy controls. Lifetime rates of 17.5% for Generalized Anxiety Disorder and 18% for PTSD were reported in this study. In a comparison with *non-obese* controls, Lundgren et al.[40] reported higher rates of Axis I comorbidity, including depression, anxiety disorders, and substance abuse disorders in the NES group.

With regard to impairment, Colles et al.[36] reported that NES alone was not associated with psychological distress, but those who also had nocturnal snacking reported lower mental health quality of life than others in this primarily obese comparison group. Ceru-Bjork et al.[15] found that individuals with nocturnal eating (but not those with full syndrome NES without nocturnal eating) had higher rates of long-term sick leave than did the obese comparison group.

Several studies of objective measures of sleep,[22] of potentially related biological parameters,[24] and of patterns of familial aggregation[27,43] have been carried out. The results of these studies are of potential interest, but have not been sufficiently well-replicated to provide a clear and convincing basis for judging the validity of NES.

Comorbidity of NES. Although a number of studies used presence of an eating disorder as an exclusion criterion, these studies did not provide a systematic account of the number of individuals who otherwise would have met diagnostic criteria for NES and, therefore, cannot be utilized to determine how common NES occurs in the context of bulimia nervosa (BN) or BED. Eight studies did, however, report comorbidity information,[17,18,26,27,33,36,37,56] with widely varying rates (and based on varying diagnostic instruments),[61–65] as shown in **Table 3**. The methodological differences across these studies (e.g., populations sampled, diagnostic criteria, and assessment instruments used) make it difficult to draw clear conclusions. Shown first is a study comprised entirely of individuals with NES[27]; of these, about 20% met diagnostic criteria for BED using the EDE,[62] a well-established research interview. The second study included a large sample of individuals with BED and, using the EDE, reported that 9.2% of BED patients reported nocturnal eating on at least half of the days/week in the past 28 days.[56] It is impossible to tell whether additional patients in this sample would have met criteria for NES using the symptom of evening hyperphagia. The lowest comorbidity estimates for an eating disorder in NES were reported in a study involving a

TABLE 4. Longitudinal or treatment studies of night eating syndrome (NES)

Study	NES Sample	Treatment	Recruitment	Assessment	Findings
Pawlow et al.[20]	19 Women, 1 man	Randomized clinical trial: daily 20-min. relaxation training/no treatment	20 Individuals with NES recruited for this study	Night Eating Questionnaire[65]	Intervention group reported significantly higher average "morning hunger" ratings (across the 7 days of the intervention) and significantly lower average "after 9 p.m. hunger" ratings than controls
O'Reardon et al.[22]	12 Women, 5 men	Open label trial of sertraline	Recruited among participants in an NES study (via print, radio/television advertisements, and a website)	10-day daily diaries (food sleep, mood), using the third to ninth day; NESS[22]	Posttest (12 weeks): significant reductions in nocturnal awakenings, nocturnal eating, and percent daily caloric intake after supper; remission: 27% of the sample
O'Reardon et al.[30]	23 Women, 11 men (3 with NES/BED, all in placebo group)	Randomized clinical trial comparing sertraline to placebo	Recruited among 65 participants in an NES study (via advertisements in print, radio/television media, and a website)	10-day daily diaries (food sleep, mood), using the third to ninth day	Posttest (8 weeks): Significant improvements in sertraline group on nocturnal awakenings, nocturnal eating, % intake after the evening meal; decrease in BMI ($p < .06$)
Stunkard et al.[32]	39 Women, 11 men	Uncontrolled trial directing physicians to prescribe sertraline	Recruited via U Penn website for NES	Telephone administered structured interview (NESHI); NESS[22]	Posttest (8 weeks): significant reductions in NESS scores, % daily intake after the evening meal, awakenings, nocturnal ingestions, depression, BMI; significant increase in quality of life
Colles et al.[40]	22 (Gender not specified)	Observational study of bariatric surgery outcome	103 Female and 26 male consecutive bariatric surgery candidates	Clinical interview	12-month follow-up: baseline NES did not predict weight loss outcome, post-surgical night eating, grazing, or uncontrolled eating

Notes: NESHI = Night Eating Syndrome History and Inventory, unpublished; NESS = Night Eating Symptom Scale.[22]

sample of African American obese outpatients, where 12.6% of NES cases met criteria for BN or BED; however, in this study among those with a BED or BN diagnosis, 33% met criteria for NES, an estimate that is quite similar to estimates of NES in BED observed in the other samples described in **Table 3**.[37]

Overall, these studies suggest considerable comorbidity between NES and BED, though rates are variable. Research is needed to clarify whether this comorbidity reflects overlap in syndrome definition or in clinical expression of the same eating disorder versus the presence of two distinct syndromes. For example, Colles et al.[40] noted that NES was more than seven times more common among binge eaters compared with nonbinge eaters and found that in individuals with full syndrome BED the most common period of experiencing loss of control over eating was between 7 and 10 p.m. It is possible that some individuals meet criteria for evening hyperphagia by virtue of consuming large amounts of food during the evening binges.

Clinical experience suggests that weight-concerned individuals (e.g., patients with BN or BED, or obese individuals) often start the day with the resolution to restrict their intake; skipping breakfast observed among individuals with NES may be the behavioral expression of this resolve rather than a symptom unique to NES.

NES versus BED. Blashfield et al.[9] recommended that there should be at least two independent, empirical studies establishing that the proposed syndrome can be distinguished from other syndromes with which it is likely to be confused. Thus, we examined the literature to determine how common other eating disorders are among individuals with NES and whether correlates or risk factors differentiate NES from other eating disorders.

Eight studies defined NES with an exclusion criterion, requiring that the night eating occur in the absence of another eating disorder. By definition, in these studies, it was not possible to examine the potential overlap of NES and other eating disorders. Several studies have compared NES with BED on clinical correlates. Allison et al.[34] compared treatment seeking individuals with NES ($n = 57$), BED ($n = 176$), or obesity (non-ED, $n = 38$) on current levels of depression using the Beck Depression Inventory (BDI II). Depression scores of NES cases were higher than those of obese controls, NES cases, and BED cases did not differ on depression scores. Colles et al.[36] recruited an Australian sample of 158 community respondents, 93 weight loss group members, and 180 bariatric surgery

candidates and compared them on BMI and several psychosocial variables. Results indicated that individuals with "comorbid NES and binge eating" and individuals with "binge eating only" scored similarly high and significantly higher than "controls" (individuals without NES or binge eating) on disinhibition, hunger, weight/shape concern, and depression (reflecting greater pathology). In contrast, "NES only" cases scored significantly lower than individuals with NES and binge eating and did not differ significantly from controls on any of the comparisons reported in the study. Hence, in this study binge eating but not night eating was associated with psychopathology.

Allison et al.[34] compared treatment seeking individuals with NES ($n = 57$), BED ($n = 176$), or obesity (non-ED, $n = 38$) on history of childhood maltreatment. Those with NES differed significantly from obesity controls only on one of five comparisons ("emotional abuse"), with 51% of NES patients and 32% of controls reporting this form of maltreatment. This difference was no longer significant when using dimensional scores for maltreatment in an analysis of covariance (adjusting for age and ethnicity). Relative to the BED group, more individuals with NES (65%) than individuals with BED (50%) reported "physical neglect." Far fewer individuals with NES (9%) than with BED (69%) reported "emotional neglect." These differences remained significant in ANCOVA model.

Clinical Course and Outcome. Yet another approach to establishing syndrome validity has been to describe the clinical course and outcome of a syndrome as well as the predictive utility of the diagnosis. We found no prospective studies of the natural course of NES, however defined, in populations that had not undergone an intervention targeting weight loss.

As reviewed in detail by Colles and Dixon,[11] a few studies have reported prevalence of NES among patients before and after undergoing bariatric surgery and the findings are mixed regarding the stability of NES in this population. Adami et al.[52] reported that of five patients with NES at baseline (of 63, 8%), four continued to exhibit NES at the 3-year postsurgery follow-up (4/63, 6%). In contrast, a 12-month observational study by Colles et al.[40] found much less stability of NES in a sample of 129 bariatric surgery patients with pre-and postassessment data. Of 17 patients with NES at baseline, only four still met diagnostic criteria at follow-up, and six new cases were detected at that time. An additional 10 patients reported nocturnal snacking at baseline and four patients reported nocturnal snacking at the 12-month follow-up (presumably,

but not stated explicitly, all four were from among the initial group of 10). It is of note that baseline NES diagnosis was not associated significantly with any of the outcome measures, including weight loss, postsurgery night eating, or other measures of eating pathology.

Two retrospective studies of changes in NES among bariatric surgery patients also reported conflicting findings. An early study of 111 bariatric surgery patients[66] reported that based on a self-report questionnaire administered during a patient reunion approximately 3 years postsurgery, 64 (57.6%) patients met criteria for NES presurgery versus 30 patients postsurgery, suggesting that a large number of patients stopped night eating after surgery yet that a considerable subset did continue. A more recent study used the EDE to collect current and retrospective accounts of nocturnal eating in a sample of 150 bariatric surgery patients who were interviewed 6 months postsurgery. Only 2% of patients reported current nocturnal eating (at least two per week), down from 55% who reported retrospectively that they experienced nocturnal eating presurgery.[55] Presurgery nocturnal eating was significantly correlated with frequency of pre-surgery binge eating. Presurgery nocturnal eating was not found to be a significant variable in a regression model using BMI lost as the dependent variable; presurgery binge frequency was significantly correlated with BMI lost and it is possible that because of the colinearity between nocturnal eating and binge eating only the latter variable remained a significant predictor.

One study found that in a sample of 76 overweight women entering a weight loss program, the 11 women who met criteria for NES had lost significantly less weight than the non-night eaters at a 1-month follow-up.[16]

In conclusion, evidence about the clinical course of NES is tentative, at best, considering the methodological limitations of this literature including small case numbers in some of the studies, retrospective assessments, questionnaire-based assessments, varying lengths of follow-up, and differing definitions of NES. Moreover, with one exception[16] only bariatric surgery patients have been studied and it is unknown whether NES remits spontaneously or whether the changes in NES in fact reflected a positive response to bariatric surgery as a treatment of obesity.

Treatment of NES. To date, very little has been published about the treatment of NES. There have been two open label trials with sertraline[22,32] and two case reports using topiramate.[67,68] Additionally,

there have been case reports using *d*-fenfluramine[69] and light therapy.[70] One small controlled study[20] ($N = 20$) found brief progressive muscle relaxation training in adults with NES decreased stress and other mood states (e.g., anxiety, depression) and lowered hunger ratings. Night time eating was reduced, though not significantly so.

The only randomized controlled trial in NES was conducted with 34 outpatients randomly assigned to receive either sertraline or placebo over an 8-week period.[30] Clinical global improvement scale ratings indicated that 12 of 17 participants receiving sertraline responded positively, with 7 of the 12 attaining complete remission of night eating syndrome symptoms. This was in comparison to only 3 of 17 placebo participants, with one attaining remission status. Hence, there is some initial support for the use of sertraline in the treatment of NES.

Gender Considerations. Two studies have reported NES to be more common in men than in women,[14,56] whereas all others have not found gender differences (**Table 2**). Yet, absent epidemiological studies it is unclear whether gender is associated with risk for NES.

Cultural Considerations. Studies of NES have occurred primarily in the US, though several studies from Australia, Denmark, Sweden, and Germany have been reported. Comparisons of prevalence estimates across studies conducted in these countries are hampered due to the varying definitions used throughout the literature and the general lack of epidemiological samples. Within the US, one study of adolescent girls found that the behavioral symptom of night eating was more common in black girls than in white girls (after adjusting for age, SES, and obesity).[50] A large community sample of adults found that night eating was reported more frequently by non-Hispanic blacks than by white and Hispanic individuals.[48]

Developmental Considerations. We found only one study that focused specifically on nocturnal eating as a clinical symptom in children. In an urban sample of 6-year-old children, Lamerz et al. reported that based on maternal report of their children's eating behavior, nocturnal eating occurred in 1.1% of the sample.[43] Based on cross-sectional data, nocturnal eating was not associated with the weight of the child. Analyses of food diaries collected from nationally representative (for the US) adolescent and adult samples showed that evening hyperphagia was most common among young adults (18–30 years) and least common among adults over the age of 65.[48]

Options for DSM-V

Option 1: Introduce NES as a New Eating Disorder in the DSM-V. An argument in favor of this option can be made in relation to a small literature based on patient samples that finds elevated levels of distress and impairment in night eaters. Moreover, the addition of NES as a new eating disorder would stimulate research in this area. A strong argument against this approach is that the literature is rife with methodological problems that preclude a clear set of diagnostic criteria at this time.

Option 2: Introduce NES as an Example of EDNOS. Introducing NES as an example of an eating disorder not otherwise specified (EDNOS) would be similar to what occurred for Binge Eating Disorder in DSM-IV, which appears to have encouraged substantial research on the disorder. Adding NES as an EDNOS diagnosis would likely stimulate research that might serve to clarify definitions for future review (also, see Option 4). However, unless all examples of EDNOS are clearly defined, this option may lead to yet a greater proportion of individuals meeting criteria for this diagnosis, thus further compounding the widely discussed problem with EDNOS as a diverse ("catch-all") category conveying insufficient information to be of clinical utility.

Option 3: Introduce Evening Hyperphagia and Nocturnal Eating as Symptom Dimensions to be Rated for each Eating Disorder. A third option would be to introduce the two major symptoms, evening hyperphagia and nocturnal eating, as symptom dimensions for each of the existing eating disorder diagnoses that could be rated as applicable. This would have the benefit of minimizing the number of eating disorder diagnoses while still acknowledging that such symptoms occur. Such an option would likely facilitate additional research in the area. However, specifying only these two dimensions would add to complexity and burden of routine assessment and potentially miss other elements of night eating that might be important (e.g., morning anorexia). A variant of this option would be to describe NES as a subtype of a broader category of binge eating problems.

Option 4: Introduce NES as a Provisional Diagnosis in Need of Further Study. A fourth option would be to introduce NES as a provisional diagnosis in need of further study as occurred in the DSM-IV for BED. Such an option would likely stimulate research, and the newly introduced criteria for diagnostic criteria could be used as a model.

Option 5: Note Evening Hyperphagia and Nocturnal Eating as Symptoms that can Worsen Medical

Conditions. Finally, night eating could be simply characterized as behaviors (evening hyperphagia and nocturnal eating) that can worsen medical conditions such as obesity. The positive argument for this approach is not evident as there is little research studying this question.

Discussion

Our review found significant limitations and gaps in the scientific literature of NES. We return for a moment to the basic question of what it is about "night eating" that is pathological. In the early description of NES, evening hyperphagia was described as a particular form of *over*eating; in contrast, in modern definitions the sole emphasis now lies on the disturbance of the timing of eating episodes. Although originally examined as a possible etiological explanation for obesity,[1] our review illustrates inconsistent empirical support in cross-sectional or prospective studies for the hypothesis that NES contributes to weight gain or obesity. Obesity occurs when more calories are ingested than are expended, but without reference to when those calories are ingested.[71] In fact, there is a literature that finds no link between eating at night and weight gain.[72–74]

When depression or distress occurs in individuals who report night eating, it is not clear whether this relates to the night eating itself or to excessive weight in those individuals. Moreover, although loss of control is not an explicit criterion in the studies or definitions of night eating, this variable may account for the distress experienced in response to overeating, as evidenced in a recent study finding that uncontrolled eating after bariatric surgery was associated with both poorer long-term weight loss and greater elevated psychological distress.[40]

Scientific evidence about the clinical utility and valid of NES is limited. The recent publication of provisional diagnostic criteria presents the opportunity for systematic collection of data about the prevalence and clinical significance of each of the symptoms as well as the possible clustering of the symptoms into a syndrome. Such studies should be based on representative samples and employ rigorous assessment protocols. Also needed are data to determine whether NES is distinct from other eating disorders. Finally, essential for consideration as a new disorder in the DSM-V is evidence about the clinical utility of a NES diagnosis.

References

1. Stunkard AJ, Grace WJ, Wolff HG. The night-eating syndrome; a pattern of food intake among certain obese patients. Am J Med 1955;19:78–86.
2. Bigsby FL, Muniz C. Control of appetite in the night eating syndrome. Successful use of an active amphetamine compound after 4:00 p.m. Med Times 1963;91:795–801.
3. Bigsby FL, Muniz C. Medical management of the tension night eater. IMJ 1967;132:306–309.
4. Birketvedt GS, Florholmen J, Sundsfjord J, Osterud B, Dinges D, Bilker W, et al. Behavioral and neuroendocrine characteristics of the night-eating syndrome. JAMA 1999;282:657–663.
5. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. Washington, DC: American Psychiatric Association, 1994.
6. Stunkard AK, Allison KC, Lundgren J. Issues for DSM-V: Night eating syndrome. Am J Psychol 2008;165:424.
7. Stunkard AJ, Allison KC, Geliebter A, Lundgren JD, Gluck ME, O'Reardon JP. Development of criteria for a diagnosis: Lessons from the night eating syndrome. Comp Psych (in press).
8. Striegel-Moore RH, Franko DL, May A, Ach E, Thompson DR, Hook J. Should night-eating syndrome be included in the DSM? Int J Eat Disord 2006;39:544–549.
9. Blashfield RK, Sprock J, Fuller AK. Suggested guidelines for including or excluding categories in the DSM-IV. Compr Psychiatry 1990;31:15–19.
10. de Zwaan M, Burgard MA, Schenk CH, Mitchell JE. Night time eating: A review of the literature. Eur Eat Disord Rev 2003;11:7–24.
11. Colles SL, Dixon JB. Night eating syndrome: Impact on bariatric surgery. Obes Surg 2006;16:811–820.
12. Mühlhans B, Olbrich K, de Zwaan M. [Night eating syndrome and nocturnal eating—What is it all about?] (German) Psychother Psychosom Med Psychol 2009;59:50–56.
13. Vinai P, Allison KC, Cardetti S, Carpegna G, Ferrato N, Masante D, et al. Psychopathology and treatment of night eating syndrome: A review. Eat Weight Disord 2008;13:54–63.
14. Aronoff NJ, Geliebter A, Zammit G. Gender and body mass index as related to the night-eating syndrome in obese outpatients. J Am Diet Assoc 2001:J101:102–104.
15. Ceru-Bjork C, Andersson I, Rossner S. Night eating and nocturnal eating-two different or similar syndromes among obese patients? Int J Obes Relat Metab Disord 2001;25:365–372.
16. Gluck ME, Geliebter A, Satov T. Night eating syndrome is associated with depression, low self-esteem, reduced daytime hunger, and less weight loss in obese outpatients. Obes Res 2001;9:264–267.
17. Napolitano MA, Head S, Babyak MA, Blumenthal JA. Binge eating disorder and night eating syndrome: Psychological and behavioral characteristics. Int J Eat Disord 2001;30:193–203.
18. Adami GF, Campostano A, Marinari GM, Ravera G, Scopinaro N. Night eating in obesity: A descriptive study. Nutrition 2002;18:587–589.
19. Birketvedt GS, Sundsfjord J, Florholmen JR. Hypothalamic-pituitary-adrenal axis in the night eating syndrome. Am J Physiol Endocrinol Metab 2002;282:E366–E369.
20. Pawlow LA, O'Neil PM, Malcolm RJ. Night eating syndrome: Effects of brief relaxation training on stress, mood, hunger, and eating patterns. Int J Obes Relat Metab Disord 2003;27:970–978.
21. Marshall HM, Allison KC, O'Reardon JP, Birketvedt G, Stunkard AJ. Night eating syndrome among nonobese persons. Int J Eat Disord 2004;35:217–222.

22. O'Reardon JP, Allison KC, Stunkard AJ. A clinical trial of sertraline in the treatment of the night eating syndrome. Int J Eat Disord 2004;35:16–26.

23. O'Reardon JP, Ringel BL, Dinges DF, Allison KC, Rogers NL, Martino NS, et al. Circadian eating and sleeping patterns in the night eating syndrome. Obes Res 2004;12:1789–1796.

24. Allison KC, Ahima RS, O'Reardon JP, Dinges DF, Sharma V, Cummings DE, et al. Neuroendocrine profiles associated with energy intake, sleep, and stress in the night eating syndrome. J Clin Endocrinol Metab 2005;90:6214–6217.

25. Allison KC, Grilo CM, Masheb RM, Stunkard AJ. Binge eating disorder and night eating syndrome: A comparative study of disordered eating. J Consult Clin Psychol 2005;73:1107–1115.

26. Allison KC, Wadden TA, Sarwer DB, Fabricatore AN, Crerand CE, Gibbons LM, et al. Night eating syndrome and binge eating disorder among persons seeking bariatric surgery: Prevalence and related features. Surg Obes Relat Dis 2006;2:153–158.

27. Lundgren JD, Allison KC, Crow S, O'Reardon JP, Berg KC, Galbraith J, et al. Prevalence of the night eating syndrome in a psychiatric population. Am J Psychol 2006;163:156–158.

28. Lundgren JD, Allison KC, Stunkard AJ. Familial aggregation in the night eating syndrome. Int J Eat Disord 2006;39:516–518.

29. Friedman S, Even C, Thuile J, Rouillon F, Guelfi JD. Night eating syndrome and winter seasonal affective disorder. Appetite 2006;47:119–122.

30. O'Reardon JP, Allison KC, Martino NS, Lundgren JD, Moonseong H, Stunkard AJ. A randomized, placebo-controlled trial of sertraline in the treatment of night eating syndrome. Am J Psychol 2006;163:893–898.

31. Rogers NL, Dinges DF, Allison KC, Maislin G, Martino N, O'Reardon JP, et al. Assessment of sleep in women with night eating syndrome. Sleep 2006;29:814–819.

32. Stunkard AJ, Allison KC, Lundgren JD, Martino NS, Heo M, Etemad B, et al. A paradigm for facilitating pharmacotherapy at a distance: Sertraline treatment of the night eating syndrome. J Clin Psych 2006;67:1568–1572.

33. Allison KC, Crow SJ, Reeves RR, West DS, Foreyt JP, Dilillo VG, et al. Binge eating disorder and night eating syndrome in adults with type 2 diabetes. Obesity (Silver Spring) 2007; 15:1287–1293.

34. Allison KC, Grilo CM, Masheb RM, Stunkard AJ. High self-reported rates of neglect and emotional abuse, by persons with binge eating disorder and night eating syndrome. Behav Res Ther 2007;45:2874–2883.

35. Boseck JJ, Engel SG, Allison KC, Crosby RD, Mitchell JE, de Zwaan M. The application of ecological momentary assessment to the study of night eating. Int J Eat Disord 2007;40:271–276.

36. Colles SL, Dixon JB, O'Brien PE. Night eating syndrome and nocturnal snacking: Association with obesity, binge eating and psychological distress. Int J Obes (Lond) 2007;31:1722–1730.

37. Jarosz PA, Dobal MT, Wilson FL, Schram CA. Disordered eating and food cravings among urban obese African American women. Eat Behav 2007;8:374–381.

38. Allison KC, Lundgren JD, O'Reardon JP, Martino NS, Sarwer DB, Wadden TA, et al. The Night Eating Questionnaire (NEQ): Psychometric properties of a measure of severity of the night eating syndrome. Eat Behav 2008;9:62–72.

39. Boston RC, Moate PJ, Allison KC, Lundgren JD, Stunkard AJ. Modeling circadian rhythms of food intake by means of parametric deconvolution: Results from studies of the night eating syndrome. Am J Clin Nutr 2008;87:1672–1677.

40. Colles S, Dixon J, O'Brien P. Grazing and loss of control related to eating: Two high-risk factors following bariatric surgery. Obesity (Silver Spring) 2008;16:615–622.

41. Lundgren JD, Allison KC, O'Reardon JP, Stunkard AJA. Descriptive study of non-obese persons with night eating syndrome

42. Lundgren JD, Newberg AB, Allison KC, Wintering NA, Ploessl K, Stunkard AJ. 123. I-ADAM SPECT imaging of serotonin transporter binding in patients with night eating syndrome: A preliminary report. Psych Res 2008;162:214–220.

43. Lamerz A, Kuepper-Nybelen J, Bruning N, Wehle C, Trost-Brinkhues G, Brenner H, et al. Prevalence of obesity, binge eating, and night eating in a cross-sectional field survey of 6-year-old children and their parents in a German urban population. J Child Psychol Psychiatry 2005;46:385–393.

44. Masheb RM, Grilo CM. Eating patterns and breakfast consumption in obese patients with binge eating disorder. Behav Res Ther 2006;44:1545–1553.

45. Morse SA, Ciechanowski PS, Katon WJ, Hirsch IB. Isn't this just bedtime snacking? The potential adverse effects of night-eating symptoms on treatment adherence and outcomes in patients with diabetes. Diabetes Care 2006;29:1800–1804.

46. Rein AK, Mühlhans B, de Zwaan M. Nocturnal eating in obese patients prior to bariatric surgery. Psychother Psychosom Med Psychol 2007;57:442–447.

47. Striegel-Moore RH, Dohm FA, Hook JM, Schreiber GB, Crawford PB, Daniels SR. Night eating syndrome in young adult women: Prevalence and correlates. Int J Eat Disord. 2005;37:200–206.

48. Striegel-Moore RH, Franko DL, Thompson D, Affenito S, Kraemer HC. Night eating: Prevalence and demographic correlates. Obesity 2006;14:139–147.

49. Striegel-Moore RH, Franko DL, Thompson D, Affenito SG, May A, Kraemer HC. Exploring the typology of night eating syndrome. Int J Eat Disord 2008;41:411–418.

50. Striegel-Moore RH, Thompson D, Franko DL, Barton BA, Affenito S, Schreiber GB, et al. Definitions of night eating in adolescent girls. Obes Res 2004;12:1311–1321.

51. Allison KC, Engel SG, Crosby RD, de Zwaan M, O'Reardon JP, Wonderlich SA, et al. Evaluation of diagnostic criteria for night eating syndrome using item response theory analysis. Eat Behav 2008;9:398–407.

52. Adami GF, Meneghelli A, Scopinaro N. Night eating and binge eating disorder in obese patients. Int J Eat Disord 1999;25:335–338.

53. American Sleep Disorder Association. International Classification of Sleep Disorders, Diagnostic and Coding Manual. Lawrence: Allen Press, 1990.

54. de Zwaan M, Roerig DB, Crosby RD, Karaz S, Mitchell JE. Nighttime eating: A descriptive study. Int J Eat Disord 2006;39:224–232.

55. Latner JD, Wetzler S, Goodman ER, Glinski J. Gastric bypass in a low-income, inner-city population: Eating disturbances and weight loss. Obes Res 2004;12:956–961.

56. Grilo CM, Masheb RM. Night-time eating in men and women with binge eating disorder. Behav Res Ther 2004;42:397–407.

57. Andersen GS, Stunkard AJ, Sørensen TI, Petersen L, Heitmann BL. Night eating and weight change in middle-aged men and women. Int J Obes Relat Metab Disord 2004;28:1338–1343.

58. Peterson CB, Crosby RD, Wonderlich SA, Joiner T, Crow SJ, Mitchell JE, et al. Psychometric properties of the eating disorder examination-questionnaire: Factor structure and internal consistency. Int J Eat Disord 2007;40:386–389.

59. Striegel-Moore RH, Franko DL. Should binge eating disorder be included in the DSM-V? A critical review of the state of the evidence. Ann Rev Clin Psych 2008;4:305–324.

60. Kendell RE. Clinical validity. Psychol Med 1989;19:45–55.

61. Wadden TA, Foster, GD. Weight and Lifestyle Inventory. Philadelphia: University of Pennsylvania, 2001.

62. Fairburn CG, Cooper Z. The Eating Disorders Examination, 12th ed. In: Fairburn CG, Wilson GT, editors. Binge Eating: Nature, Assessment, and Treatment. New York: The Guilford Press, 1993, pp 317–331.

63. Kutlesic V, Williamson DA, Gleaves DH, Barbin JH, Murphy-Eberenz KP. The interview for the diagnosis of eating disorders–IV: Application to DSM-IV diagnostic criteria. Psychol Assess 1998;10:41–48.

64. Yanovski SZ. Binge eating disorder: Current knowledge and future directions. Obes Res 1993;1:306–324.

65. Wadden TA, Phelan S. Behavioral assessment of the obese patient. In: Wadden TA, Stunkard AJ, editors. Handbook of Obesity Treatment. New York: The Guilford Press, 2002, pp 186–226.

66. Rand CS, Macgregor AM, Stunkard AJ. The night eating syndrome in the general population and among postoperative obesity surgery patients. Int J Eat Disord 1997;22:65–69.

67. Tucker P, Masters B, Nawar O. Topiramate in the treatment of comorbid night eating syndrome and PTSD: A case study. Eat Disord 2004;12:75–78.

68. Winkelman JW. Treatment of nocturnal eating syndrome and sleep-related eating disorder with topiramate. Sleep Med 2003;4:243–246.

69. Spaggiari MC, Granella F, Padrino L, Marchesi C, Melli I, Terzano MG. Nocturnal eating syndrome in adults. Sleep 1994;17:339–344.

70. Friedman S, Even C, Dardennes R, Guelfi JD. Light therapy, obesity, and night-eating syndrome. Am J Psychol 2002;159:875–876.

71. Vreeman RC, Carroll AE. Medical myths. Brit Med J 2008;337:a2769.

72. Bertéus Forslund H, Lindroos AK, Sjöström L, Lissner L. Meal patterns and obesity in Swedish women-a simple instrument describing usual meal types, frequency and temporal distribution. Eur J Clin Nutr 2002;56:740–747.

73. Andersson I, Rössner S. Meal patterns in obese and normal weight men: The "Gustaf" study. Eur J Clin Nutr 1996;50:639–646.

74. Consoli A, Capani F, Del Ponte A, Guagnano T, Iezzi M, Ditano G, et al. [Effect of scheduling of meal times on the circadian rhythm of energy expenditure] (in Italian). Boll Soc Ital Biol Sper 1981;57:2322–2324.