

UCSF

UC San Francisco Previously Published Works

Title

Self-reported eating disorders and sleep disturbances in young adults: a prospective cohort study.

Permalink

<https://escholarship.org/uc/item/0wh7n1pt>

Journal

Eating and Weight Disorders: studies on anorexia, bulimia and obesity, 26(2)

Authors

Nagata, Jason

Thurston, Idia

Karazsia, Bryan

et al.

Publication Date

2021-03-01

DOI

10.1007/s40519-020-00888-6

Peer reviewed



Published in final edited form as:

*Eat Weight Disord.* 2021 March ; 26(2): 695–702. doi:10.1007/s40519-020-00888-6.

## Self-Reported Eating Disorders and Sleep Disturbances in Young Adults: A Prospective Cohort Study

Jason M. Nagata, M.D., M.Sc.<sup>1</sup>, Idia B. Thurston, Ph.D.<sup>2</sup>, Bryan T. Karazsia, Ph.D.<sup>3</sup>, Daniel Woolridge, M.D., M.P.H.<sup>1</sup>, Sara M. Buckelew, M.D., M.P.H.<sup>1</sup>, Stuart B. Murray, Ph.D.<sup>4</sup>, Jerel P. Calzo, Ph.D., M.P.H.<sup>5</sup>

<sup>1</sup>Department of Pediatrics, University of California San Francisco, San Francisco, CA

<sup>2</sup>Department of Psychological & Brain Sciences, Texas A&M University, College Station, TX

<sup>3</sup>Department of Psychology, The College of Wooster, Wooster, OH

<sup>4</sup>Department of Psychiatry, University of California San Francisco, San Francisco, CA

<sup>5</sup>Division of Health Promotion & Behavioral Science, School of Public Health, San Diego State University, San Diego, CA

### Abstract

**Purpose**—To evaluate the prospective association between eating disorders, disordered eating behaviors, and sleep disturbances in young adults.

**Methods**—We used prospective cohort data of young adults ages 18–26 from the National Longitudinal Study of Adolescent to Adult Health (N=12,082). Self-reported exposures of interest (at 18–26 years) included 1) an eating disorder diagnosis proxy; disordered eating behaviors such as 2) restrictive eating behaviors including fasting/skipping meals, 3) compensatory behaviors including vomiting, laxatives/diuretics, or weight loss pills; and 4) loss of control/overeating. Self-reported sleep disturbances at seven-year follow-up included trouble falling or staying asleep.

**Results**—In negative binomial regression models, all four exposures predicted both sleep disturbance outcomes at seven-year follow-up, when adjusting for demographic covariates and baseline sleep disturbances. When additionally adjusting for baseline depressive symptoms, the associations between eating disorder diagnosis proxies and trouble falling (incidence rate ratio

---

Terms of use and reuse: academic research for non-commercial purposes, see here for full terms. <https://www.springer.com/aam-terms-v1>

**Corresponding Author:** Jason M. Nagata, 550 16th Street, 4<sup>th</sup> Floor, Box 0110, San Francisco, California 94158, [jasonmnagata@gmail.com](mailto:jasonmnagata@gmail.com).

**Conflicts of interest:** The authors have no conflicts of interest to report

Compliance with ethical standards

**Ethical approval:** The University of North Carolina Institutional Review Board approved all Add Health study procedures. All procedures performed in this study were in accordance with the ethical standards of the university's Institutional Review Board and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent:** Written consent was obtained from the parent if the participant was under age 18, or from the participant if 18 or older.

**Publisher's Disclaimer:** This Author Accepted Manuscript is a PDF file of an unedited peer-reviewed manuscript that has been accepted for publication but has not been copyedited or corrected. The official version of record that is published in the journal is kept up to date and so may therefore differ from this version.

[IRR] 1.24; 95% CI 1.05–1.46) and staying (IRR 1.16; 95% CI 1.01–1.35) asleep remained statistically significant; however, the associations between eating behaviors and sleep disturbances were attenuated.

**Conclusions**—Eating disorders in young adulthood predict sleep disturbances at seven-year follow-up. Young adults with eating disorders or who engage in disordered eating behaviors may be assessed for sleep disturbances.

**Level III**—Evidence obtained from well-designed cohort or case-control analytic studies.

### Keywords

eating disorder; disordered eating; young adult; sleep; binge eating; overeating; loss of control; dietary restriction; bulimic episodes; purging; depression

## Introduction

Eating disorders (EDs; i.e., anorexia nervosa, bulimia nervosa, binge eating disorder) affect approximately 2% of adults in the US [1]. EDs are often lifelong conditions that are difficult to treat and are associated with substantial physical and mental health comorbidity. Engagement in disordered eating behaviors (DEB; e.g., restrictive eating behaviors, compensatory behaviors, or loss of control/overeating) is more common than EDs [1] and is associated with the development of ED and other adverse health conditions, including sleep disturbances [2]. In contrast, sleep disturbances, such as difficulty initiating sleep, difficulty maintaining sleep, and waking earlier than usual, affect approximately 27% of adults in the US [3].

ED symptomatology is associated with initial and mid-sleep disturbances [4], with the degree of sleep disturbance appearing proportional to the severity of ED symptomatology [5]. The mechanisms underpinning the association between sleep disturbances and ED/DEB risk are complex, and likely involve an interplay of neurological and endocrine regulation (i.e., leptin, orexin, ghrelin) associated with malnutrition, disrupted eating, weight cycling, and co-occurring mental health and environmental stressors (e.g., depression) [2]. Sleep disturbances are strongly related to depression [6, 7] and there is high comorbidity between EDs and depression [2]. The association between ED/DEB and sleep disturbance may be particularly salient during the young adult period (18–26 years old), as this developmental period is often characterized by considerable opportunities and life transitions that can introduce numerous stressors (e.g., starting college, moving out of the family home, pressure to become financially independent and/or experiencing financial hardship) that likely increase vulnerability for DEB, ED, and sleep disturbance [1].

While studies suggest that persistence of poor sleep predicts severity of eating disorder symptoms [8–10], there is limited large-scale, long-term, prospective research examining the directional relationship from eating disorder symptoms to sleep disturbance. Given the possible bidirectional intersection between sleep disturbance and EDs [11–13], it is important to investigate the understudied research area of how eating disorder symptoms may be prospectively associated with sleep disturbances. For instance, the Minnesota starvation experiments showed that a state of semi-starvation can lead to sleep disturbances,

raising the notion that malnutrition may impact sleep [14]. Importantly, few systematic studies have examined this possibility. Furthermore, prospective longitudinal research can aid in demonstrating the directionality of associations between types of ED/DEB at baseline and subsequent sleep disturbance, while adjusting for baseline sleep disturbance. While one study has demonstrated this direction with two-year follow-up [4], others have had mixed findings [2]. Demonstrating persistent associations for longer follow-up periods can contribute to evidence demonstrating the long-term health consequences of ED/DEB. In addition, it is important to delineate the contribution of co-occurring health conditions which also impact sleep, such as depressive symptoms. The goal of this study is to evaluate the association between ED, DEB, and sleep disturbance in a US nationally representative sample of young adults, and explore the contributing role of depressive symptoms to the associations.

## Methods

### Study population

We conducted secondary analysis of data from the National Longitudinal Study of Adolescent to Adult Health. Specifically, data from participants from Wave III (young adults ages 18–26,  $n = 14,322$ ) who were followed into Wave IV (ages 24–31) were examined. The original Wave I sample of this study was nationally representative with respect to ethnicity, region, size, type, and urbanicity of students from high schools and middle schools ( $n = 80$ ) throughout the United States. For the current analyses, participants enrolled at Wave III who were lost to follow-up at Wave IV and participants with missing data on primary variables were excluded ( $n = 2,240$ ). Additional information about study design has already been published [13]. The Institutional Review Board of the University of North Carolina approved all data collection and storage procedures.

### Measures

#### Exposure Variables (Wave III)

**Proxies of Eating Disorder Diagnosis:** Participants were asked, “Have you ever been told by a doctor that you have an eating disorder, such as anorexia nervosa or bulimia?” Those that responded “yes” were categorized as having a diagnosed ED similar to prior studies [1].

**Eating behaviors:** Participants who indicated they were trying to lose weight or stay the same weight were asked, “Which of the following things did you do during the past seven days in order to lose weight or stay the same weight?” Response options included 1) fasting or skipping meals, 2) making yourself throw up, 3) laxatives, 4) diuretics, or 5) taking weight loss pills. Restrictive eating behaviors were defined as fasting or skipping meals whereas compensatory behaviors were defined as making yourself throw up or taking laxatives, diuretics, or weight loss pills, similar to prior studies [1, 16]. The eating behavior questions were adapted from validated behavior measures such as the Adolescent Health Survey and similar to Project Eating Among Teens [1, 17]. The time frame of the questions was seven days to be consistent with the seven-day time frame of other validated questions in the Add Health survey on nutrition and physical activity.

**Overeating or loss of control eating:** Consistent with prior secondary analysis with this data [16], overeating/loss of control eating was defined as present when individuals self-reported that they have “eaten so much in a short period of time that [they] would have been embarrassed if others had seen them do it” or who indicated that they have “been afraid to start eating because they thought they wouldn’t be able to stop or control your eating” in the past seven days [18]. These questions were adapted from validated eating behavior measures such as in the Adolescent Health Survey and similar to Project Eating Among Teens (89% agreement) [1, 17].

### Outcome measures (Wave IV, seven-year follow-up)

**Proxies of Sleep Disturbances—**Trouble falling asleep was based on a response to the interview question, “Over the past four weeks, how often did you have trouble falling asleep?” Trouble staying asleep was based on a response to the interview question, “Over the past four weeks, how often did you have trouble staying asleep through the night? For example, you woke up several times at night or woke up earlier than you planned to.” Response options for both questions included: 0) never in the past four weeks, 1) less than once a week, 2) 1 or 2 times a week, 3) 3 or 4 times a week, and 4) 5 or more times a week as have been previously reported and published [19]. At baseline, “trouble falling or staying asleep” was combined into one question.

### Covariates

**Depression—**A nine-item version of the Center for Epidemiologic Studies-Depression Scale (CES-D) [20] was used to assess depressive symptomatology during Wave III. Respondents indicated how often nine statements related to depression had occurred during the previous 7-day period. The CES-D sleep item “my sleep was restless” was not retained in the scale score used in this analysis.

Age, sex, and race/ethnicity size were recorded based on self-report [15]. Household income and parents’ highest education was based on self-report from the baseline parent interview. Gaussian normal regression imputation method was used to impute household income for the parents who either refused to answer the questions or stated they did not know. Body mass index (BMI) was based on interviewer-measured height and weight ( $BMI = \text{weight}/\text{height}^2$ ).

### Statistical analysis

We analyzed data using STATA 15.0, setting statistical significance threshold set at a two-sided alpha of 0.05. We incorporated Add Health’s pre-constructed sample weights for all analyses to yield nationally representative estimates. Given the approximate negative binomial distribution of the sleep outcome count variables, we used negative binomial regression for regression analyses [21]. Negative binomial regression analyses were used to identify associations with sleep (trouble falling and staying asleep at seven-year follow-up) as the dependent variables, and ED/DEBs as the independent variables, adjusting for age, sex, race/ethnicity, household income, parents’ highest education, body mass index, and baseline self-reported sleep disturbances, with or without baseline depression. BMI is linked to both EDs and sleep disturbance and is adjusted for as a potential confounder [2].

Depression is an important covariate to consider when assessing the relationship between ED and sleep disturbance, given that sleep disturbance is strongly related to depression [2], and the comorbidity between ED and depression [22]. Negative binomial regression coefficients were transformed to incidence rate ratios [21]. Sensitivity analyses were conducted with slightly modified independent variables, such as eating disorder diagnosis proxies with specific eating behaviors (restrictive eating, compensatory, and overeating/loss of control) and specific eating behaviors excluding those with eating disorder diagnosis proxies.

## Results

Demographic and descriptive characteristics for the analytic sample are presented in Table 1. Prospective associations between indices of disordered eating and the two sleep disorder constructs are reported in Table 2. While controlling for demographics, proxies of an ED diagnosis and reports of all disordered eating behaviors were all associated with both self-reported sleep disturbance outcomes. An ED diagnosis proxy (versus no ED diagnosis proxy) was associated with a 36% increase (95% confidence interval: 16%–59%) for each category of trouble falling asleep. When baseline depression was added to the model, baseline depression was also significantly associated with difficulties falling asleep and staying asleep. In the context of depression, incidence rate ratios for DEBs were attenuated and not independently significantly associated with self-reported sleep disturbance outcomes, with the exception of restrictive eating behaviors and difficulty falling asleep whose association remained statistically significant. The associations between ED diagnosis proxy and subsequent sleep outcomes remained statistically significant even when adjusting for depression and demographic covariates.

In sensitivity analyses, participants with an ED diagnosis proxy who engaged in restrictive eating had significant difficulties falling asleep, but there were not significant associations with other specific disordered eating behaviors among participants with an ED diagnosis proxy (Appendix A). When participants with an ED diagnosis proxy were excluded from the analyses, the association between restrictive eating behaviors and difficulty falling asleep was attenuated but other associations were similar.

## Discussion

Sleep disturbance has been associated with DEBs and ED diagnoses among adult populations, with limited research examining this relationship over time among young adults. Young adulthood is a particularly critical period in the life course when stressors abound due to numerous life changes [23] and it is a time when issues relating to EDs and sleep disturbance may be particularly salient [1, 2]. Thus, the current study prospectively examined the associations between ED diagnosis proxy, disordered eating behaviors, and self-reported sleep disturbance (i.e., trouble falling asleep and trouble staying asleep) among 18 to 26 year olds, while accounting for contributions of baseline depressive symptoms.

Broadly, our findings reveal a prospective relationship between ED diagnosis proxies and subsequent self-reported sleep disturbances seven years later. Prior research suggests that

persistence of poor sleep predicts severity of ED symptoms [8, 9]. For instance, poor sleep quality has been shown to be associated with disinhibited eating [11, 12] and emotional overeating [12]. However, the relationship between eating disorder symptoms and sleep may be bidirectional. Yet, there is a dearth of research examining ED symptoms predicting poor sleep and thus this remains a gap in the literature. One prior study showed that disordered eating behaviors predicted difficulties initiating and maintaining sleep at one- and two-year follow-up [4], and our current study extends these findings to seven-year follow-up. In terms of specific disordered eating behaviors, we found that restrictive eating behaviors, compensatory behaviors, and overeating/loss of control eating were prospectively associated with self-reported sleep disturbances. This is in accord with prior literature demonstrating sleep disturbances among clinical samples with anorexia nervosa which often involves restrictive eating behaviors [2]. Furthermore, prior literature has reported an association between bulimic behaviors and sleep disturbance at two-year follow-up [4], similar to our finding of an association between compensatory behaviors and sleep disturbances at seven-year follow-up. Other samples have found an association between sleep quality with overeating among toddlers [12].

Interestingly, even after accounting for sociodemographics and baseline depressive symptoms, the relationship between ED diagnosis proxies and self-reported sleep disturbance remained. Controlling for baseline depression attenuated the relationship between disordered eating behaviors and overeating/loss of control and self-reported sleep disturbances. There is strong evidence demonstrating the effects of sleep on depression [6, 7]; however, the literature examining depression as a predictor of sleep is more sparse and thus worthy of investigation given possible bidirectional relationships. One prior study found that depression fully mediated the positive association between binge frequency among individuals with binge eating disorder and insomnia symptoms [24]. Furthermore, a bidirectional link between eating behavior and sleep has been hypothesized. Further understanding the complex relationships among these variables is an important area for future research.

These findings accord with previous literature documenting a relationship between ED psychopathology and sleep disturbances [4, 5, 25], although they add to the current evidence base by (i) using a longitudinal cohort study design of a large, nationally representative sample of US young adults, (ii) extending the length of follow-up, (iii) delineating specific dimensions of ED psychopathology and self-reported sleep disturbances, and (iv) controlling for potentially salient confounders.

However, there are some limitations to consider. First, all measures used in this project, including eating behaviors and sleep disturbances, were based on self-report of a few or single items, which is subject to reporting bias. Second, due to the design of the Add Health survey, we were unable to measure the severity or duration of reported DEBs. The presence of ED psychopathology was not measured at follow-up, and thus we were unable to investigate whether self-reported sleep disturbances also predict eating disorder diagnosis proxies and disordered eating at follow-up and we cannot delineate whether the association between disordered eating and self-reported sleep disturbances at follow-up reflects a residual effect of disordered eating, or the impact of ongoing disordered eating. Third,

White, female participants with higher socio-economic status were more likely to be retained at follow-up which could lead to selection bias (Appendix B). Fourth, although we controlled for a number of potential confounders including age, biological sex, race, ethnicity, household income, parental education, body mass index, and baseline depression, there is the possibility for unmeasured confounders (e.g., anxiety (or some other variable) that may be driving or contributing to these associations). Given the observational nature of the data we cannot establish causality.

Notwithstanding, the current study is novel in illustrating the prospective association between a wide array of eating-related disturbances and sleep quality among young adults, while controlling for depression and sociodemographic variables. This adds to the literature demonstrating the short- and long-term detrimental impact of eating disorders and disordered eating on health outcomes spanning nearly every organ system [26, 27]. Findings suggests that people caring for young adults with EDs and DEBs may consider assessing for sleep function. Further research considerations to explore possible mechanisms underpinning the robust relationship between ED psychopathology and sleep disturbances, and their temporal interaction are needed. Future investigations in this area could examine clinical ED samples, with inclusion of clinical assessment of all ED diagnoses and severity of eating pathology. Overall, the robustness of our findings highlight the unique contributions of EDs and DEBs to sleep disturbances even after accounting for depression.

### Acknowledgements

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due to Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis.

**Funding:** J.M.N. is a participant in the Pediatric Scientist Development Program (K12HD00085033), funded by the American Academy of Pediatrics and the American Pediatric Society, and the American Heart Association Career Development Award (19CDA34760281).

### Appendix

#### Appendix A.

Prospective associations between proxies of eating disorder diagnosis with certain eating behaviors, eating behaviors in the absence of eating disorder diagnosis proxies, and sleep disturbance constructs, adjusted for demographic and socio-economic covariates<sup>a</sup>

Adjusted for covariates <sup>a</sup>		Adjusted for covariates and depression <sup>a</sup>	
Falling Asleep	Staying Asleep	Falling Asleep	Staying Asleep
IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)

Eating disorder diagnosis proxies with specific behaviors



	Adjusted for covariates <sup>a</sup>		Adjusted for covariates and depression <sup>a</sup>	
	Falling Asleep	Staying Asleep	Falling Asleep	Staying Asleep
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Eating disorder with restrictive eating behaviors	1.81 (1.42–2.29) <sup>***</sup>	1.27 (0.94–1.72)	1.53 (1.17–2.02) <sup>**</sup>	1.12 (0.80–1.57)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>
Eating disorder with compensatory behaviors	1.43 (0.98–2.10)	1.17 (0.75–1.81)	1.21 (0.74–1.96)	1.01 (0.61–1.67)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>
Eating disorder with overeating/loss of control	1.28 (0.81–2.04)	1.18 (0.83–1.68)	1.10 (0.58–1.77)	1.05 (0.72–1.52)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>
Disordered eating behaviors, excluding participants with eating disorder diagnosis proxies				
Restrictive eating behaviors <sup>b</sup>	1.14(1.05–1.24) <sup>**</sup>	1.10 (1.01–1.20) <sup>*</sup>	1.07 (0.99–1.17)	1.05 (0.96–1.14)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>
Compensatory behaviors <sup>c</sup>	1.14 (1.01–1.28) <sup>*</sup>	1.17 (1.04–1.31) <sup>*</sup>	1.08 (0.96–1.21)	1.13 (1.00–1.27)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>
Overeating/loss of control eating	1.21 (1.09–1.34) <sup>***</sup>	1.20 (1.09–1.32) <sup>***</sup>	1.09 (0.97–1.21)	1.11 (1.00–1.23)
Depression			1.04 (1.04–1.05) <sup>***</sup>	1.03 (1.03–1.04) <sup>***</sup>

<sup>a</sup>All models adjusted for age, race/ethnicity, biological sex, household income, parental education, body mass index, and baseline sleep disturbances.

<sup>b</sup>Restrictive eating behaviors include fasting or skipping meals

<sup>c</sup>Compensatory behaviors include vomiting, laxatives, diuretics, or weight loss pills for weight loss

IRR=Incidence rate ratio

\* p<0.05

\*\* p<0.01

\*\*\* p<0.001

### Appendix B.

Comparison of characteristics of participants in the National Longitudinal Study of Adolescent to Adult Health at Wave III who were included versus excluded<sup>a</sup>

	Included	Excluded	p
<b>N=14,322</b>	<b>12,082</b>	<b>2,240</b>	
	<b>Mean ± SD / %</b>	<b>Mean ± SD / %</b>	
Age (years)	21.96 ± 1.76	22.17 ± 1.80	<0.001 <sup>b</sup>
Biological sex			<0.001 <sup>c</sup>

	Included	Excluded	p
<b>N=14,322</b>	<b>12,082</b>	<b>2,240</b>	
	<b>Mean ± SD / %</b>	<b>Mean ± SD / %</b>	
Female	44.2%	54.4%	
Male	55.8%	45.6%	
Race/Ethnicity			<0.001 <sup>c</sup>
White (non-Hispanic)	56.4%	47.2%	
Black/African American (non-Hispanic)	20.4%	21.6%	
Hispanic/Latino	15.7%	19.1%	
Asian/Pacific Islander (non-Hispanic)	6.2%	10.3%	
American Indian/Native American	0.6%	0.9%	
Other	0.7%	0.9%	
Parent highest educational attainment			<0.001 <sup>c</sup>
Less than high school	14.7%	17.3%	
High school graduate	27.8%	27.1%	
Some college	22.2%	22.1%	
College graduate	35.3%	33.6%	
Household income (thousands of U.S. dollars)	46.95 ± 45.96	43.39 ± 36.52	<0.001 <sup>b</sup>
Body mass index (kg/m <sup>2</sup> )	26.60 ± 6.37	25.99 ± 6.05	<0.001 <sup>b</sup>

SD = standard deviation

<sup>a</sup>Excluded due to loss-to follow-up or missing data, national sample weighting not incorporated into these analyses

<sup>b</sup>Independent samples T-test

<sup>c</sup>Pearson's chi square test

## References

- Nagata JM, Garber AK, Tabler J, Murray SB, Bibbins-Domingo K (2018) Prevalence and Correlates of Disordered Eating Behaviors among Young Adults with Overweight or Obesity. *J Gen Intern Med* 33:1337–1343. doi: 10.1007/s11606-018-4465-z. [PubMed: 29948810]
- Allison KC, Spaeth A, Hopkins CM (2016) Sleep and Eating Disorders. *Curr Psychiatry Rep* 18:92. doi: 10.1007/s11920-016-0728-8. [PubMed: 27553980]
- Olfson M, Wall M, Liu S, Morin CM, Blanco C (2018) Insomnia and Impaired Quality of Life in the United States. *J Clin Psychiatry* 79. doi: 10.4088/JCP.17m12020.
- Bos SC, Soares MJ, Marques M, Maia B, Pereira AT, Nogueira V, Valente J, Macedo A (2013) Disordered eating behaviors and sleep disturbances. *Eat Behav* 14:192–198. doi: 10.1016/j.eatbeh.2013.01.012. [PubMed: 23557819]
- Aspen V, Weisman H, Vannucci A, Nafiz N, Gredysa D, Kass AE, Trockel M, Jacobi C, Wilfley DE, Taylor CB (2014) Psychiatric co-morbidity in women presenting across the continuum of disordered eating. *Eat Behav* 15:686–693. doi: 10.1016/j.eatbeh.2014.08.023. [PubMed: 25462028]
- Baglioni C, Battagliese G, Feige B, Spiegelhalder K, Nissen C, Voderholzer U, Lombardo C, Riemann D (2011) Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. *J Affect Disord* 135:10–19. doi: 10.1016/j.jad.2011.01.011. [PubMed: 21300408]
- Gregory AM, Rijdsdijk FV, Lau JYF, Dahl RE, Eley TC (2009) The direction of longitudinal associations between sleep problems and depression symptoms: a study of twins aged 8 and 10 years. *Sleep* 32:189–199. doi: 10.1093/sleep/32.2.189. [PubMed: 19238806]

8. Lombardo C, Battagliese G, Venezia C, Salvemini V (2015) Persistence of poor sleep predicts the severity of the clinical condition after 6 months of standard treatment in patients with eating disorders. *Eat Behav* 18:16–19. doi: 10.1016/j.eatbeh.2015.03.003. [PubMed: 25845312]
9. Lombardo C, Battagliese G, Baglioni C, David M, Violani C, Riemann D (2014) Severity of insomnia, disordered eating symptoms, and depression in female university students. *Clin Psychol* 18:108–115. doi: 10.1111/cp.12023.
10. Goel NJ, Sadeh-Sharvit S, Trockel M, Flatt RE, Fitzsimmons-Craft E, Balantekin KN, Monterubio GE, Firebaugh M, Wilfley DE, Taylor CB (2020) Depression and anxiety mediate the relationship between insomnia and eating disorders in college women. *Journal of American College Health*:1–6. doi: 10.1080/07448481.2019.1710152.
11. Blumfield ML, Bei B, Zimberg IZ, Cain SW (2018) Dietary disinhibition mediates the relationship between poor sleep quality and body weight. *Appetite* 120:602–608. doi: 10.1016/j.appet.2017.10.022. [PubMed: 29042189]
12. Miller AL, Miller SE, LeBourgeois MK, Sturza J, Rosenblum KL, Lumeng JC (2019) Sleep duration and quality are associated with eating behavior in low-income toddlers. *Appetite* 135:100–107. doi: 10.1016/j.appet.2019.01.006. [PubMed: 30634008]
13. Cooper AR, Loeb KL, McGlinchey EL (2019) Sleep and eating disorders: current research and future directions. *Curr Opin Psychol* 34:89–94. doi: 10.1016/j.copsyc.2019.11.005. [PubMed: 31841832]
14. Keys A (1950) *The biology of human starvation*. Minneapolis, University of Minnesota Press.
15. Harris KM, Halpern CT, Whitsel E, Hussey J, Tabor J, Entzel P, Udry JR (2017) *The National Longitudinal Study of Adolescent to Adult Health: Research Design*. [https://www.cpc.unc.edu/projects/addhealth/design/researchdesign\\_3618\\_regular.pdf](https://www.cpc.unc.edu/projects/addhealth/design/researchdesign_3618_regular.pdf). Accessed Nov 6, 2019.
16. Fergus KB, Copp HL, Tabler JL, Nagata JM (2019) Eating disorders and disordered eating behaviors among women: Associations with sexual risk. *Int J Eat Disord*. doi: 10.1002/eat.23132.
17. Neumark-Sztainer D (2010) Project EAT 2010 and F-EAT Surveys - Derived Variables and Scales. [http://docs.sph.umn.edu/epich/eat/EAT2010\\_FEAT\\_Psychometrics.pdf](http://docs.sph.umn.edu/epich/eat/EAT2010_FEAT_Psychometrics.pdf). Accessed Jan 2, 2020.
18. Sonnevile KR, Thurston IB, Milliren CE, Gooding HC, Richmond TK (2016) Weight misperception among young adults with overweight/obesity associated with disordered eating behaviors. *Int J Eat Disord* 49:937–946. doi: 10.1002/eat.22565. [PubMed: 27218865]
19. Fricke J, Sironi M (2017) Dimensions of sexual orientation and sleep disturbance among young adults. *Prev Med Rep* 8:18–24. doi: 10.1016/j.pmedr.2017.07.008. [PubMed: 28831369]
20. Radloff LS (1977) The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement* 1:385–401. doi: 10.1177/014662167700100306.
21. Hilbe JM (2011) *Negative binomial regression* Cambridge, Cambridge University Press.
22. Mischoulon D, Eddy KT, Keshaviah A, Dinescu D, Ross SL, Kass AE, Franko DL, Herzog DB (2011) Depression and eating disorders: Treatment and course. *Journal of Affective Disorders* 130:470–477. doi: 10.1016/j.jad.2010.10.043. [PubMed: 21109307]
23. Park MJ, Scott JT, Adams SH, Brindis CD, Irwin CE (2014) Adolescent and young adult health in the United States in the past decade: little improvement and young adults remain worse off than adolescents. *J Adolesc Health* 55:3–16. doi: 10.1016/j.jadohealth.2014.04.003. [PubMed: 24815958]
24. Kenny TE, Van Wijk M, Singleton C, Carter JC (2018) An examination of the relationship between binge eating disorder and insomnia symptoms. *Eur Eat Disord Rev* 26:186–196. doi: 10.1002/erv.2587. [PubMed: 29542203]
25. Trace SE, Thornton LM, Runfola CD, Lichtenstein P, Pedersen NL, Bulik CM (2012) Sleep problems are associated with binge eating in women. *Int J Eat Disord* 45:695–703. doi: 10.1002/eat.22003. [PubMed: 22331832]
26. Katzman DK (2005) Medical complications in adolescents with anorexia nervosa: a review of the literature. *Int J Eat Disord* 37 Suppl:S52–9. doi: 10.1002/eat.20118 [doi]. [PubMed: 15852321]
27. Nagata JM, Garber AK, Tabler J, Murray SB, Vittinghoff E, Bibbins-Domingo K (2018) Disordered Eating Behaviors and Future Cardiometabolic Risk among Young Adults with Overweight or Obesity. *Int J Eat Disord* 51:931–941. doi: 10.1002/eat.22927. [PubMed: 30030944]

**What is already known on this subject?**

Prior literature indicates that eating disorders and disordered eating behaviors may be associated with sleep disturbances, although findings have been mixed.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**What does this study add?**

Using nationally representative longitudinal cohort data from the USA, we find a prospective relationship between self-reported eating disorder diagnosis, disordered eating behaviors, and subsequent sleep disturbances seven years later.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**Table 1.**

Demographic and health characteristics of 12,082 young adult participants in the National Longitudinal Study of Adolescent to Adult Health

	%	Mean (SE)
Age (years)		21.77 (0.12)
Biological sex		
Female	50.6%	
Male	49.4%	
Race/Ethnicity		
White (non-Hispanic)	69.4%	
Black/African American (non-Hispanic)	15.0%	
Hispanic/Latino	11.4%	
Asian/Pacific Islander (non-Hispanic)	3.0%	
American Indian/Native American	0.5%	
Other	0.7%	
Parent highest educational attainment		
Less than high school	14.5%	
High school graduate	30.0%	
Some college	22.6%	
College graduate	32.9%	
Household income (thousands of U.S. dollars)		46.22 (1.38)
Body mass index (kg/m <sup>2</sup> )		26.52 (0.13)
Eating disorder and behavior exposures at baseline		
Eating disorder diagnosis proxies	2.1%	
With restrictive eating behaviors	0.5%	
With compensatory behaviors	0.3%	
With overeating/loss of control eating	0.3%	
Any disordered eating behavior	17.0%	
Restrictive eating behaviors <sup>a</sup>	9.0%	
Any compensatory behavior <sup>b</sup>	4.0%	
Vomiting to lose weight	0.2%	
Laxatives to lose weight	0.3%	
Diuretics to lose weight	0.3%	
Weight loss pill	3.5%	
Overeating or loss of control eating	7.2%	
Trouble falling or staying asleep at baseline		
Never in the past four weeks	39.4%	
Less than once a week	36.1%	
1 or 2 times a week	14.2%	
3 or 4 times a week	7.7%	
5 or more times a week	2.6%	
Sleep outcomes at seven-year follow-up		

	%	Mean (SE)
Trouble falling asleep		
Never in the past four weeks	47.1%	
Less than once a week	18.6%	
1 or 2 times a week	18.0%	
3 or 4 times a week	8.5%	
5 or more times a week	7.8%	
Trouble staying asleep		
Never in the past four weeks	43.1%	
Less than once a week	17.7%	
1 or 2 times a week	17.6%	
3 or 4 times a week	9.8%	
5 or more times a week	11.9%	

All means and percentages are calculated with weighted data to reflect the representative proportion in the target U.S. population

<sup>a</sup> Restrictive eating behaviors include fasting or skipping meals

<sup>b</sup> Any compensatory behaviors include vomiting, laxatives, diuretics, or weight loss pills for weight loss

**Table 2.**

Prospective associations between indices of disordered eating and sleep disturbance constructs, adjusted for demographic and socio-economic covariates<sup>a</sup>

	Adjusted for covariates <sup>a</sup>		Adjusted for covariates and depression <sup>a</sup>	
	Falling Asleep	Staying Asleep	Falling Asleep	Staying Asleep
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Diagnosis				
Eating disorder diagnosis proxies	1.36 (1.16–1.59) ***	1.25 (1.09–1.43) **	1.24 (1.05–1.46) **	1.16 (1.01–1.35) *
Depression			1.04 (1.04–1.05) ***	1.03 (1.03–1.04) ***
Disordered eating behaviors				
Restrictive eating behaviors <sup>b</sup>	1.18 (1.08–1.28) ***	1.11 (1.02–1.20) **	1.10 (1.01–1.20) *	1.05 (0.97–1.14)
Depression			1.04 (1.04–1.05) ***	1.03 (1.03–1.04) ***
Compensatory behaviors <sup>c</sup>	1.15 (1.03–1.30) **	1.16 (1.04–1.30) **	1.08 (0.96–1.21)	1.11 (0.99–1.25)
Depression			1.04 (1.03–1.05) ***	1.03 (1.03–1.04) ***
Overeating/loss of control eating	1.21 (1.09–1.34) ***	1.19 (1.09–1.31) ***	1.08 (0.97–1.21)	1.10 (1.00–1.22)
Depression			1.04 (1.04–1.05) ***	1.03 (1.02–1.04) ***

<sup>a</sup>All models adjusted for age, race/ethnicity, biological sex, household income, parental education, body mass index, and baseline sleep disturbances.

<sup>b</sup>Restrictive eating behaviors include fasting or skipping meals

<sup>c</sup>Compensatory behaviors include vomiting, laxatives, diuretics, or weight loss pills for weight loss

IRR=Incidence rate ratio

\* p<0.05

\*\* p<0.01

\*\*\* p<0.001