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Sleep, Depressive/Anxiety Disorders, and Obesity in Puerto Rican Youth

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Abstract

Objective—Adolescents from Puerto Rican backgrounds are found to have higher rates of obesity than adolescents from other ethnic groups in the US. The objective of this study is to examine whether sleeping the recommended number of hours and depression or anxiety disorder are independently related to risk for obesity in a sample of Island Puerto Rican adolescents, and whether the association between sleep and obesity is moderated by depression or anxiety disorder

Methods—Data from the study were derived from the third wave of an island wide probability sample of Puerto Rican youth residing on the Island, 10 to 25 years of age ($N=825$), with a response rate of 79.59%. The current study focuses on youth 10 to 19 ($n=436$).

Results—In this sample, youth who slept less than the recommended number of hours (defined as 7 to 9 hours per night) had a significantly increased risk for obesity and were three times as likely to be obese. Youth who met criteria for a depressive/anxiety disorder were almost 2.5 times as likely to be obese. However, the presence of an anxiety/depressive disorders did not moderate the association between sleeping the recommended number of hours and risk for obesity.

Conclusion—Sleeping less than the recommended number of hours may be an important risk factor for obesity status in Island Puerto Rican youth. These findings suggest that attention to healthy sleep behaviors and a sleep environment that promotes high quality sleep may be important for Puerto Rican adolescents at risk for obesity.

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Informed consent: Informed consent was obtained from all individual participants included in the study.

Keywords

Sleep; obesity risk; Puerto Rican youth

INTRODUCTION**Obesity Risk in Puerto Rican Youth**

Island Puerto Rican (PR) adolescents have higher rates of obesity (33%) compared to adolescents from other Latino ethnic subgroups living in the mainland US (e.g., Mainland PRs), and adolescents from other ethnic groups (Venegas, Perez, Suarez, & Guzman, 2003). More recent Island-wide population-based studies reported rates of 21.5% for obesity in Island PR youth (Acosta-Perez et al., 2012; Garza et al., 2011). More research is needed to identify modifiable lifestyle factors that contribute to risk for obesity in this group.

Adolescence is a critical time for intervention, given health behaviors developed during this time can affect later adult health outcomes (Friedman, 1993; Maggs, Schulenberg, & Hurrelman, 1997). Intervening earlier to minimize or prevent obesity risk during adolescence is crucial, as such efforts can decrease future risk for cardiovascular disease, diabetes, and other health complications related to obesity in adulthood (Kozak et al., 2011).

Sleep and Obesity Risk

The amount of hours spent asleep during the night is a central component of optimal health, development, and cognitive functioning in youth, particularly when the amount of sleep is consistent with what is recommended for the individual's developmental level (Mindell, Owens, & Carskadon, 1999). Insufficient sleep has been linked to behavioral disorders in children and adolescents (Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010). A variety of factors may contribute to risk for obesity in youth who do not sleep the recommended number of hours (Cappuccio et al., 2008). For example, it has been suggested that shorter sleep duration may increase obesity risk through the influence of hormonal responses which may increase appetite and caloric intake (Miller & Cappuccio, 2007; Vgontzas, Bixler, & Chrousos, 2003). Insufficient sleep is associated with reciprocal changes in leptin and ghrelin (Miller & Cappuccio, 2007; Vgontzas et al., 2003), which can increase appetite and risk for obesity. Inflammatory pathways that may be activated by an insufficient amount of sleep have also been implicated in the development of obesity (Miller & Cappuccio, 2007). Finally, it has been suggested that shorter or longer sleep may be an indicator of unfavorable health status and lifestyle characteristics consistently associated with obesity status (Knutson & Turek, 2006; Patel, Malhotra, Gottlieb, White, & Hu, 2006).

Specific groups may be more prone to an inappropriate amount of sleep, such as individuals at specific periods of development and specific ethnic groups. A recent "Sleep in America Poll" shows that only 20% of adolescents sleep the recommended number of hours for their age range (National Sleep Foundation, 2010). Further, studies show that Latino youth in the US have poorer sleep quality than Non-Latino Whites (NLWs; Patel, Grandner, Xie, Branas, & Gooneratne, 2010). Moreover, Latino children and adolescents have higher rates of other sleep disorders such as insomnia, hypersomnia, and sleep disordered breathing (SDB)

compared to their NLW counterparts (Goodwin et al., 2003; O'Connor et al., 2003; Roberts, Roberts, & Chen, 2000). These studies have not identified which Latino ethnic subgroups may be most at risk with respect to sleep problems. An increasing trend towards not sleeping the recommended number of hours even in NLW adolescents has been noted, along with growing support for an association between sleep duration and risk for obesity in NLW adolescents (Chen, Beydoun, & Wang, 2008; Patel & Hu, 2008).

Many factors across multiple levels (developmental, biological, cultural, environmental, etc.) may affect why individuals may not sleep the recommended number of hours (see review by Boergers & Koinis-Mitchell, 2010). Examining the association between sleeping the recommended number of hours and weight status in specific groups of Latino youth, such as Island PRs, is an important area of study, given that this group is at high risk for obesity and that studies typically have not focused on sleep in this high risk group. Furthering understanding of modifiable factors that may underlie the association between sleeping the recommended number of hours and weight status in Island PR youth can inform targeted interventions. For example, culturally-tailored interventions that focus on enhancing sleep hygiene may have the potential to decrease obesity risk in this group.

Depression and Anxiety: Risk Factors for Insufficient Sleep and Overweight/Obesity

The prevalence rates of depression and anxiety disorder have been found to be very high (e.g., 11 to 15%) among Island PR youth (Acosta et al., 2012; Angold et al., 2002; Canino et al., 2004). Further, an association between sleep problems and anxiety disorders in youth has been demonstrated in children from Latino backgrounds (Alfano, Pina, Zerr, & Villalta, 2010). Results from one study suggest that sleep onset latency is associated with increased anxiety, depressive symptoms, and emotional eating in minority children (Nguyen-Rodriguez, McClain, & Spruijt-Metz, 2010). Again, these two studies that focused on internalizing disorders such as anxiety or depression and sleep did not specify Latino ethnic groups that may be most at risk. It is possible that the association between sleep and risk for obesity may be affected by the presence of anxiety and/or depressive symptoms, as increased symptoms may contribute to difficulty falling or staying asleep, and in turn, increase risk for obesity. These associations need to be further examined in specific groups at increased high risk for anxiety and/or depressive disorders and obesity, such as Island PR youth.

The current study is one of the first to examine the role of sleeping the recommended number of hours on obesity risk in Island PR Youth (aged 10–19) who currently reside on the Island, as well as the potential moderating role of internalizing disorders (anxiety and/or depression disorder) on the association between sleeping the recommended number of hours and obesity. The results of this study have the potential to inform future research studies and culturally-tailored interventions focusing on sleep and obesity in Island PR youth. We hypothesize that not sleeping the recommended number of hours of sleep and depressive and anxiety disorders will each independently increase the risk for obesity in our sample. We also expect that depression and anxiety disorders will moderate the association between sleeping the recommended number of hours and obesity risk, such that the association

between not sleeping the recommended number of hours of sleep and increased obesity risk will be more apparent in youth who have either an anxiety or depression disorder.

METHODS

Sample Design

Data for this study are from the third wave of the Asthma, Depression and Anxiety in Island PR Youth (ADA) Study, that was conducted during 2005–2008, and was designed to assess the prevalence and correlates of psychiatric disorders and service utilization among Island PR youth 4 to 17 years of age. Details regarding the sampling design and procedures have been previously described for wave 1 and 2 (Canino et al., 2004; Feldman, Ortega, McQuaid, & Canino, 2006; Nguyen-Rodriguez et al., 2010). To summarize, at wave 1, an island wide household probability sample of children, aged 4 to 17 years, was drawn based on four strata: Puerto Rico's health regions, urban vs. rural areas, participant age, and participant gender. Block groups based on the 1990 United States Census for Puerto Rico were the primary sampling unit. Clusters of households were randomly selected from each stratum. Households with children aged 4 to 17 years were randomly selected, and one child was randomly selected from each household. At wave 1, from 2,102 eligible households, 1,886 caregiver-child dyads were interviewed for a total response rate of 90.1%. At wave 2, 1,789 caregiver-child dyads with children aged 5 to 18 were interviewed for a 94.9% retention rate at this one- year follow-up.

Because this larger study was focused on asthma, an oversampling of children with asthma was an important element of the sampling design of the third wave. Therefore, for wave 3, all youth from wave 2 who had reported ever having a physician diagnosis of asthma and also met criteria for the DSM-IV Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) for any threshold and sub-threshold of anxiety and or depressive disorder ($n=176$) were identified. In addition, 20% of a random sample of the remaining original sample from wave 2 was selected. For the current study, this resulted in 825 households, of which 656 youth 10 to 25 years of age were interviewed for a response rate of 79.5%. Although 176 out of the 656 youth included in the current study had a caregiver report of physician-diagnosed asthma, our sampling approach involved an estimation of design weights that ensured our sample was representative of the population of youth on the Island (see below). Because the current study for this report focuses on youth and not on young adults, we only included the caregiver-youth dyads with youth between the ages of 10 and 19 ($n=436$) at the time of the wave 3 data collection. Thus, we excluded youth ($n=220$) who were between the ages of 20 to 25 years for the current analyses. Further, the present manuscript includes data only from wave 3 of the larger ADA study; only the wave 3 data included all measures necessary to evaluate the central constructs of the present manuscript, i.e., only wave 3 collected data on sleeping the recommended number of hours. The study was approved by the Institutional review boards (IRB) of the University of Puerto Rico, Medical Sciences Campus and the University of California, Los Angeles.

Survey Administration: Procedures

During the prior two waves of the study, all participants had signed a consent form allowing our study staff to re-contact them for future studies. We located many participants through the mail for the next two study waves, and those who could not be contacted through mail were followed-up by telephone to describe each study and assess interest in participating. Once families expressed continued interest in participating in each wave, two interviewers, one for the caregiver and another for the youth, conducted interview-based assessments in the families' homes. When possible, children and caregivers were interviewed simultaneously in separate rooms by different interviewers.

Interviewers administered interview-based assessments using laptop computers. Interviewers asked each question to the caregiver, and entered their response. If the caregiver and child agreed, interviews were audiotaped and subsequently spot-checked for quality control. There is ample evidence that children and caregivers do not agree on their responses to diagnostic interviews (Grills & Ollendick, 2002; Jensen et al., 1999; Kraemer et al., 2003) and therefore, interviewers of the caregiver or youth were not aware of the responses obtained by the other interviewer. This prevented interviewers' attitudes from being contaminated by knowledge of the other interviewee's responses. Caregiver consents, youth assents, and young adult consents for participants 18 years and older were obtained. The Consent form was reviewed with the participant prior to the interview.

Given that the current study involved youth of a wide age range, and given that for some variables, caregivers are known to be better informants for younger children than the children themselves (Kraemer et al., 2003), we used caregiver report for the majority of study indicators, while the youth were informants on psychiatric symptoms and a limited number of other constructs. For example, youth weight and height information were obtained via caregiver report for minor youth below 18 years of age, as we believed caregivers were more valid reporters of children's weight and height information. Adult youth who were 18 and 19 years of age provided information on their weight and height. Caregivers and youth were interviewed regarding the mental health of the youth (anxiety/depression). Only youth were interviewed on the number of hours spent asleep each night. Thus, only the procedures for the reporting of information on youth height and weight differed based on the age of the youth and we acknowledge that this as a limitation in our study design. The average length of the interview varied by informant, with the caregiver's interview lasting an average of two hours, while the youth's interview lasted an average of an hour and a half. Several other assessments not relevant to this report were included, which increased the length of the interview.

Survey Measures

Sociodemographics—Socio-demographic variables reported by caregivers included: education, marital status, work status, income, household members, perception of poverty, and the youth's age, gender, and number of years in school.

Caregivers reported their *perception of poverty* as: living well, living from check to check, or living poorly. Perception of poverty based on caregiver report has been found to be more

strongly associated with mental and physical health outcomes in this sample than other indicators of poverty status (Gore, Aseltine, & Colton, 1992). Further, this indicator was used instead of other indicators of poverty, such as household income or caregiver education, because prior analyses showed no associations of psychiatric disorders with either income or caregiver education (Canino et al, 2004). The items used to assess perception of poverty were adapted from a previous measure (Gore et al., 1992), which has been used in a number of other studies in Puerto Rico (Canino et al, 2004) and the US (Roberts et al, 2000).

Physical activity: Along with the sociodemographic variables assessed above, the level of physical activity of youth was assessed as a potential covariate. Physical Activity was assessed by caregiver report of how many days a week the youth engaged in physical activity. A two item PACE+ Adolescent Physical Activity Measure assessed the number of days youth had accumulated at least 60 minutes of MVPA (moderate-to-vigorous-intensity physical activity) per day during the past seven days and for a typical week (Prochaska et al., 2001). This measure assesses youth compliance to the federal recommendation of at least 60 minutes of MVPA daily (U.S. Department of Agriculture, 2005). A score is derived of the number of days per week during which the youth accumulated 60 minutes of MVPA. Five or more days per week met the federal guideline for youth (USDA, 2005).

Anxiety and Depression: Anxiety and Depression were measured using the official Spanish translation of the Diagnostic Interview Schedule for Children and Youth (DISC-IV; Bravo et al., 2001). The DISC-IV is a structured instrument used for the assessment of DSM-IV psychiatric disorders in pediatric populations (American Psychiatric Association, 1994). The Spanish version of the DISC-IV was found to be as reliable in 6 to 17 year old PR youth as the English version of the same instrument (Bravo et al., 2001). There is a child version in which the child reports psychiatric symptoms in relation to himself/herself and a caregiver version in which the caregiver or caretaker reports symptoms of the child.

The DISC-IV has three time frames, last month, last year and lifetime. In this study only the last year time frame was used. Psychiatric diagnoses are made by computerized algorithms based on the full DSM-IV criteria. Although continuous symptom scales can be derived from the DISC-IV, in this study, we used only the computer algorithms based on DSM-IV to assess the dichotomous presence/absence of a depressive or anxiety disorder. Both child and caregiver versions are identical in wording and scoring except for the fact that the child version asks the child directly about his/her symptoms, and the caregiver version asks the caregiver in relation to the index child.

The following specific DSM-IV anxiety disorders were measured for both children and their caregivers in the present study: generalized anxiety, panic, social phobia, separation anxiety, or post-traumatic stress disorder during the past year. Specific depressive disorders included major depression and dysthymia. Specific anxiety disorders were combined into a higher rank category of anxiety disorders. Likewise, the two specific depressive disorders were combined into one category of depressive disorders (Shaffer et al., 1996). We applied the DISC-IV algorithm (version M) to measure threshold-specific psychiatric disorders. We combined caregiver and youth reports by following an OR rule, which involves positively scoring any symptom that is endorsed by either the caregiver or child.

All questions for each specific disorder module start with an introduction. For example, the section on separation anxiety starts with the following introduction; “Some [children/young people] get very upset or nervous when they are not with their parents or with the grown-ups who usually look after them. I am going to ask you some questions about that.” A representative item of the parent separation anxiety module includes the following: “In the last year, that is, since [month/year 12 months earlier], was there a time when [name of child] often wanted to stay at home and not go [to school/work, or other] places without[you/or other attachment figure] ?” If this item is endorsed, the next set of questions assess for duration and severity of these experiences. A representative item of the parent major depressive disorder module includes the following: “In the last year, that is since [month/year 12 months earlier], was there a time when [name of child] seemed sad or depressed? If this item is endorsed, the next questions assess for frequency and severity of these ” symptoms (see Shaffer et al., 1996). Coding responses are for all these representative items are: 0 = *No*, 2 = *Yes*, 7 = *Refused*, 9 = *Don’t know*.

These exact items were asked to the child in relation to himself/herself.

The test-retest reliability of the Spanish version of the DISC-IV was found to be as reliable in 6 to 17 year old PR youth as the English version (Shaffer et al, 1996) of the same instrument (Bravo et al., 2001). The last year higher rank category of the anxiety disorder module of the Spanish translation had a kappa statistic of .51 and the last year higher rank category of depressive disorders module of the Spanish translation had a kappa statistic of .42 (Bravo et al, 2001).

Body Mass Index—BMI was calculated from caregivers’ estimation of their children’s height and weight for youth 10 to 17 years of age. Youth 18 and 19 years of age provided information on their own height and weight. We plotted BMI on the Center for Diseases Control and Prevention growth charts for age and gender to obtain a percentile ranking (Center for Disease Control, 2010). In accordance with CDC’s defined BMI cut-off scores, obesity status was defined by a BMI equal to or greater than the 95th percentile based on the youth’s height and weight. Overweight was defined by a BMI equal to the 85th percentile but less than the 95th percentile; healthy weight by a BMI equal or greater than the 5th percentile but less than the 85th percentile. Underweight was defined by a BMI less than the 5th percentile. We also included participants’ BMI percentiles as a continuous variable, and included results from analyses with this variable as a secondary aim with regard to the examination of sleep hours and obesity risk. We elected to utilize BMI percentiles as the unit of measurement as they are easy to understand and interpret.

Sleeping the recommended number of hours: Sleeping the recommended number of hours was ascertained by asking the youth the following question: How many hours do you sleep each night? Each response option was reviewed for each participant and included: 4 or less hours, 5 hours, 6 hours etc., up until 9 hours, or 10 or more hours. Based on current National Sleep Foundation recommendations, the amount of hours that youth reported they currently slept were divided into three categories, divided into three categories: “sleeping the recommended/appropriate number of hours given an individual’s age” (seven, eight or nine hours); “ sleeping less than the recommended number of hours” (less than seven hours of

sleep); and “sleeping more than the recommended number of hours” (ten or more hours); as reported in the 2010 Sleep in America Poll (National Sleep Foundation, 2010).

Analysis

Analyses were weighted to correct for the complex multi-stage sample design that otherwise would have caused probabilities of selecting subjects to deviate from U.S. Census Bureau data for the general population of PR youth in the year 2008. The estimation of design weights. The estimation of design weights used to make our sample representative of the population of Puerto Rican youth was accomplished in two stages. First, during the third wave, the subjects’ probability of selection was estimated and a further adjustment for the response rate was made. The probability of selection took into account the fact that for wave 3, different numbers of subjects were selected from four strata of different sizes (based on their anxiety, depression, and asthma status in the previous wave). The inverse of the probability of selection was used to estimate sampling weights that determined the number of subjects drawn from each of the strata that formed the sampling frame. The design weights estimated during this first stage served the purpose of making the sample representative of the population of Puerto Rican youth in the year 2000 based on the 2000 Census Bureau data were similar to those used for the sample obtained at wave 2.

In the second stage, a further adjustment was made to the sample design weights by applying a post-stratification adjustment to the population of Puerto Rican youth in the year 2008 based on the US Census Bureau data. This post-stratification was conducted based on the distributions of gender and age, which were divided into 3 age categories that represented the age of participants in wave 3. The categories were 10 to 14 years, 15 to 19 years, and 20 to 25 years (Note: As described above, although wave 3 included individuals aged 20 to 25 years, this report focuses on youth from the two younger age categories, 10 to 14 and 15 to 19 years of age). We utilized standard methods for determining the representativeness of an epidemiological sample as in our prior work (Acosta-Perez et al., 2012; Canino et al., 2004).

SUDAAN software release 11.0 was used to conduct the analyses, which allows for the analysis of data obtained from a complex sample design. The software takes into account stratification and unequal weighting and clustering (non-independence of observations) when estimating standard errors for parameter estimates in statistical models. In SUDAAN, a replacement design was used without a finite population correction. The estimating algorithm was a Taylor series linearization method. The statistical model used was a contingency table analysis. For regression models, we utilized Generalized Estimating Equations. The probabilistic distribution for the response function was the binomial distribution and the link function was the logit. The regression model used was analogous to logistic regression for simple random samples. Standard errors in the regression models were estimated using the sandwich estimator resulting in robust standard errors (Binder, 1983).

The ad/hoc automatic solution used by SUDAAN for estimating variances when strata or clusters have only one unit was specifically avoided by selecting only one level of stratification of the primary sampling unit (PSU). In our current analysis, we used

geographical region as the stratification variable. In this approach, there were no strata or clusters with only one unit; using only one unit can be problematic for variance estimation with complex sample designs such as the present design.

Depressive and anxiety disorders were collapsed into one category referred to as internalizing disorders (depressive/anxiety). This increased statistical power and is clinically acceptable since both disorders are within the broader category of internalizing or emotional disorders (Brook, Zhang, Saar, & Brook, 2009). Similarly, we collapsed overweight, normal weight, and underweight into one category (non-obese) in order to increase the number of subjects in the reference group, increase statistical power, and reduce the number of parameters to be estimated.

The main study questions focused on obesity status. Number of sleeping hours did not differ significantly from the recommend category of 7–9 hours per night in youth who were in the overweight, normal weight, and underweight status groups; however, number of sleeping hours did differ significantly from that recommendation in youth who were in the obese weight status group. Given that sleeping the recommended number of hours was only related to the obesity status group and not to the other weight groups, we categorized the weight status groups into obese and non-obese status. As a secondary goal, for all regression analyses, including obesity status, we also examined BMI percentiles as a continuous variable.

Two simple logistic regression models were first used to assess the independent association between sleeping the recommended number of hours and obesity status and the association between depressive/anxiety disorders and obesity status, using BMI cut-off scores (Model 1, Table 2). In these models, we did not adjust for other covariates. Obesity was regressed on a three-category hours of sleep variable: sleeping the recommended number of hours of sleep (7–9 hours), less than the recommended number of hours (< 7 hours), and more than the recommended number of hours (10 hours or more). A separate model involved obesity status regressed on depressive/anxiety disorder. We then conducted a multiple logistic regression, which simultaneously included the hours of sleep three-category variable and the depressive/anxiety disorder variable in the same model, to, to examine whether adjusting for each variable changed each of their respective associations with obesity status, using the BMI cut-off scores (Model 2, Table 2). These models did not include additional potential covariates.

The next multiple logistic regression models were similar to the previous ones described above, but with adjustment for covariates. Covariates were introduced into the model simultaneously in a single step to control for potential confounders in the relationship with obesity status. The covariates included child's gender, child's lifetime asthma diagnosis, primary caretaker's obesity status, and child's level of physical activity (Model 3, Table 2). Odds ratios, ratio of the predicted marginal, and prevalence risk ratios were estimated and are defined and summarized below in the context of the presentation of the regression results.

We then conducted the same regression models described above substituting the BMI percentile scores for the BMI cut-off scores to represent weight status (Table 3). For these

models that included a continuous dependent variable (BMI percentiles), simple or multiple regressions were conducted using the generalized estimating equations framework with robust standard errors. Similar to the regression models we used for a dichotomous dependent variable, the estimating algorithm was Taylor series linearization methods.

Finally, to test whether depression/anxiety disorders moderated the association between sleep and obesity risk, we also estimated one model with an additional interaction term, between sleep hours and anxiety/depression diagnosis, and another model using an alternative interaction term, between sleep hours and severity level of an anxiety/depression diagnosis. Thus, possible moderation was tested in two ways; using depression/anxiety as a dichotomous variable (diagnosis yes or no) and also as a continuous variable defined as the child's total number of anxiety and depressive symptoms. These regression models testing for a moderation effect were conducted with the BMI cut-off scores (Tables 4 and 5) representing obesity status as the dependent variable, and with BMI percentile scores (Tables 6 and 7) representing weight status as the dependent variable.

RESULTS

Demographics

Table 1 presents the demographics of the sample by obesity group. There was a statistically significant difference between the two groups in gender composition. The obese group had a higher percentage of males than the non-obese group. The difference was approximately 15%. There were no significant differences by mean age in the two groups. With regard to socioeconomic characteristics and household composition, there were no significant differences in either household income or perception of poverty between the two groups.

Differences in Sleeping the recommended number of hours, Depressive/anxiety disorders, and Sociodemographics by Obesity Status (using BMI cut-off scores)

Among the obese group, there was a significantly higher percentage of youth who slept less than the recommended numbers of hours (<7 hours) as compared to the percentage of youth in the non-obese group who slept less than the recommended number of hours (<7 hours). The percentage of youth in the obese group who slept less than 7 hours was about twice as much as the percentage of youth who slept less than the recommended number of hours in the non-obese group (23.5% vs. 11.57%, Chi-Square = 4.82, $df=1$, $p=.03$). The magnitude of this difference must be interpreted with caution; because of the reduced number of obese youth who slept less than 7 hours, the standard errors of these parameters are high and this affects the precision of the confidence intervals.

There were also differences between the two groups in the prevalence of depressive/anxiety disorder. The prevalence of depressive/anxiety disorder was twice as large in the obese group compared to the non-obese group, chi-square = 5.82, $df=1$, $p=.02$. In terms of weight categories, among the non-obese group, being underweight was very rare and most youth could be described as having a healthy weight. However, a significant percentage of youth (above 20%) were overweight, that is, at least 1 in 5 was overweight. About 21.5% of youth were obese, or 1 in 5 youth in the total group were obese. The obese group was more likely

to be male, more likely to sleep less than the recommended number of hours, more likely to meet criteria for a depressive/anxiety disorder, and to have an asthma diagnosis.

Regression models

Sleeping the recommended number of hours, Anxiety/Depressive Disorder, and Obesity Risk (using BMI cut-off scores)—Table 2 presents the summary of results from the regression models used to predict risk for obesity status in the sample. The first two simple logistic regression models quantified the independent association between sleeping the recommended number of hours and obesity status and depressive/anxiety disorders and obesity status, in separate unadjusted models (Table 2, Models 1a and 1b). Both variables were significant predictors of a higher risk of obesity. Youth who slept less than the recommended number of hours had almost three times the odds of being obese. Youth who met criteria for a depressive/anxiety disorder were almost 2.5 times as likely to be obese. Sleeping less than the recommended number of hours increased the risk of obesity by more than 100%; the prevalence risk ratio was 2.18, and so the risk (as measured by the prevalence of obesity) more than doubled. Further, sleeping less than the recommended number of hours increased the risk of depressive/anxiety disorder by about 94%, i.e., the prevalence risk ratio in those who were depressed was 1.94 times larger than the risk for the non-depressed. However, because of the small sample size and complex sample design, and because the 95% CIs for these ratios are large, these estimates need to be considered with caution.

The next model presents the results of a multiple logistic regression of obesity on sleep and anxiety/depressive diagnosis simultaneously (Table 2, Model 2). This allowed us to examine if controlling for either variable mitigates the risk associated with the other variable. Both predictors continued to be significantly associated with obesity and the level or risk was only slightly attenuated when controlling for the other risk factor.

The next multiple logistic regression model presented in Table 2 (Model 3) is the previous model adjusting for all other covariates (gender, child physical activity, child's asthma, and adult primary caretaker obesity), including both predictors (hours of sleep and depressive/anxiety disorder) simultaneously. The omnibus hypothesis that all covariates in the model were unrelated to obesity was rejected, Wald $F = 6.47$, $df = 6$, $p < .0001$.), therefore we proceeded to interpret the significance of our individual predictors. Sleeping less than the recommended number of hours significantly increased the risk for obesity. As reflected in the prevalence risk ratio of 2.06 in Table 2 (Model 3), the risk of obesity increased by more than 100%.

With regard to the covariates in model 3, youth level of physical activity was not significantly related to the risk for obesity in the sample. However, having an obese primary caretaker was associated with a higher risk for obesity. Youth with an obese caregiver were more than three times as likely to be obese. The presence of child asthma was also associated with an increased likelihood of being categorized as obese. Gender was not significantly associated with obesity, although there was a possible trend for male youth being more likely to be obese than females.

Prevalence risk ratios in for each predictor in Table 2 can be interpreted as estimates of the expected or average value of the BMI dependent variable if everyone in the sample was in the same BMI category (after adjusting for all other predictors in the regression model). These point estimates are the ratio of the predicted marginals for a specific predictor in the regression model. In the present analyses, the reference group for estimating either the odds ratios or prevalence risk ratios is youth who slept between 7 and 9 hours, the recommended number of hours. With respect to the predicted marginals in model 3 of Table 2, if all youth in the sample had slept the recommended number of hours, the model adjusted prevalence of obesity would have been predicted at 17% ($SE = 3\%$). For youth in the sample who slept less than 7 hours the corresponding prediction would have been 36% ($SE = 7\%$); thus, the effect of sleeping less than the recommended number of hours in our sample is a point estimate of a 19% increase in the proportion of participants classified as obese. The corresponding predicted marginals for a depressive/anxiety disorder were estimated respectively at 20% ($SE = 3\%$) and 29% ($SE = 6\%$). However, as shown in Model 3, after adjusting for the covariates, depressive/anxiety disorder was not significantly associated with the proportion of participants classified as obese ($p = .17$), possibly due to the association of youth asthma with the presence of a depressive/anxiety disorder.

Regression models using a continuous BMI measure for weight status—

Ordinary regression models were used to analyze data for BMI percentiles as the dependent variable for weight status. The analyses used percentile raw scores as the metric rather than standardized scores. Results showed that only youth who slept less than the recommended number of hours (see Table 3, Model 1a and 1b) had, on average, higher BMI than youth who slept the recommended number of hours. In the multiple regression model that was unadjusted for relevant covariates (Table 3, Model 2), this association failed to reach statistical significance ($p = .062$). Sleeping more than the recommended number of hours was also not significantly related to the continuous measure of the BMI in either the simple or the multiple regression models (Table 3, Models 1a, 1b, and 2) In this model, having a depressive or anxiety disorder was also not predictive of BMI percentile scores.

The final multiple linear regression model (Table 3, Model 3) included all covariates; results showed that only sleeping less than the recommended number of hours of sleep significantly increased youth BMI, and by 11.5 percentiles. Having a depressive/anxiety disorder had no effect on BMI percentile scores, and neither did youth physical activity. However, parental obesity and child asthma were associated with a statistically significant increase in average BMI percentile scores. Being male was associated with nearly significantly higher BMI scores than being female.

Regression models testing the potential moderating role of depressive/anxiety disorder—We also tested for a potential moderating effect of depressive/anxiety disorder on the relationship between hours of sleep and obesity. Two non-additive models were estimated to evaluate if depression/anxiety moderated the effects of not sleeping the recommended number of hours on obesity risk using the BMI cut-off scores. Models were estimated using both categorical (diagnosis) and continuous (sum of DISC symptoms) measures of depression/anxiety disorder. All adjustment covariates were included in the

model when testing for a possible moderation effect. For both types of measures, no evidence was found of a moderating effect of depression/anxiety disorders for the observed association between sleeping the recommended number of hours and obesity. The results from these analyses were not significant (Table 4 and 5).

We re-ran the moderational analyses described above including BMI as a continuous variable to represent weight status (Table 6 and 7). The first model tested for moderation using a categorical dichotomous variable representing the presence or absence of a depressive/anxiety disorder. In this model the interactions of anxiety/depressive disorder with sleeping less than 7 hours or sleeping 10 or more hours were estimated separately. The omnibus test for the full 2 degrees of freedom interaction was not statistically significant ($p = .65$); results did not support the view that sleeping hours is moderated by the presence of a depressive/anxiety diagnosis. The individual regression coefficients representing the interaction of sleeping less than the recommended number of hours and depressive/anxiety diagnosis ($p = .95$) or sleeping more than the recommended number of hours and depressive/anxiety diagnosis ($p = .39$) also did not reach statistical significance. The same results were obtained (Table 7) when using depressive/anxiety level of severity as the moderation variable. Since our sample size is small for testing interactions, these results should be interpreted with caution.

DISCUSSION

This population-based study showed that sleeping less than the recommended number of hours (less than 7 hours for this age group) and having a depressive/anxiety disorder were both independently and in combination, associated with an increased risk of obesity in our sample of Island PR youth. However, even when adjusting for demographics and a prevalent, co-morbid chronic medical illness (i.e., asthma) in this group of youth, sleeping less than the recommended number of hours was still associated with an increased risk of obesity in this sample. The contribution of depressive/anxiety disorders in the adjusted model may have been minimized when we accounted for asthma; our previous research has shown consistent associations between asthma and anxiety and depressive symptoms (e.g., Acosta-Perez et al., 2012). Future research needs to test the potential impact of depressive/anxiety symptoms on obesity risk in PR youth without chronic medical conditions such as asthma.

Further, a prevalence of 21.5% of obesity was observed among this sample of Island PR youth, which appears to be consistent with the high prevalence rates in the Island PR population (Acosta-Perez et al., 2012; Garza et al., 2011; Langellier, Martin, Canino, Garza, & Ortega, 2012). Some research has supported an association between not sleeping the recommended number of hours and risk for obesity among children and adolescents from other ethnic groups (Chen et al., 2008; Patel & Hu, 2008). However, this association has not been consistently found across studies, particularly in studies that included children of different age groups and ethnic backgrounds (Lytle et al., 2012), which suggests that further research is needed in this area. Moreover, in this study, the association between sleeping the recommended number of hours and weight status was examined by using BMI cut-off scores, which grouped children into obese or non-obese group. We also used BMI percentile scores as an indicator of weight status to examine study questions. Results from both

methods showed that youth in our sample who slept less than the recommended number of hours were more at risk for obesity and for a higher BMI percentile score.

Despite the well-established association between depression/anxiety and sleep in children and adolescents (Alfano et al., 2010; Taylor, Lichstein, Durrence, Reidel, & Bush, 2005), our results showed that for this sample of Island PR youth, having a depressive/anxiety disorder did not moderate the association between sleeping the recommended number of hours and risk for obesity. Further research is needed to clarify whether such disorders have more of a moderating influence on other sleep indicators (e.g., sleep onset latency, sleep quality) and weight status for specific subgroups of youth (e.g., youth who are overweight vs. obese). It is also possible that anxiety and depression each have unique effects on sleep and weight status. Further, recent research has shown that insufficient sleep early in life may precede symptoms of anxiety and depression, suggesting potential links between psychiatric comorbidities, sleep, and metabolism and weight that require further investigation to clarify pathways of influence (Jansen et al., 2011). Finally, a recent study including Latino children showed that common variations in obesity genes (FTO, TMEM18 and NRXN3) were associated with the vulnerability for metabolic complications, which may be related to insufficient sleep (Prats-Puig et al., 2012); this suggests that the association between sleeping the recommended number of hours and obesity risk is complex and may not be consistent across individuals or groups.

Several limitations of this study should be noted. Although a validated self-report questionnaire was used, information regarding other indicators of sleep (e.g., sleep quality, sleep onset latency, and potential sleep disordered breathing) were not assessed. Future studies including objective assessments of sleep (e.g., using actigraphy) may provide a more accurate assessment of whether or not individuals sleep the recommended number of hours (Koinis-Mitchell, Craig, Esteban, & Klein, 2012).

Moreover, with respect to the unadjusted prevalence risk ratios, because of our small sample size and complex sample design, these estimates were not very precise. In addition, our sample size was reduced since we had a total of $n=57$ subjects whose obesity status could not be determined due to missing data. We considered using modern imputation methods to deal with this issue but elected to not use this approach since our data set did not include covariates that enabled us to impute obesity status.

The cross-sectional nature of the study design also does not permit us to infer causality in the associations between sleeping the recommended number of hours, obesity, and depressive/anxiety disorders. Further, the directionality in the association between these indicators was not confirmed by the analyses conducted; thus, future research examining their pathway of influence is needed.

This is the first study to examine the association between sleeping the recommended number of hours and obesity risk among an Island wide representative sample of PR youth. However, future work is needed to test these associations in additional Latino ethnic groups, and to evaluate whether improving sleep assists in decreasing weight for youth from a variety of Latino groups. In addition, further research is needed to clarify potential

pathophysiological mechanisms as well as lifestyle factors (physical activity, nutrition/eating) and cultural beliefs about sleep, which may assist in addressing why PR youth on the Island who sleep less than the recommended number of hours may be at increased risk for obesity. Having a depressive/anxiety disorder did increase risk for obesity, which may suggest that psychotherapeutic interventions to address anxiety and depressive symptoms may decrease risk for obesity. However, having an anxiety/depressive disorder did not moderate the association between sleeping the recommended number of hours and obesity status. Again, future research is needed to confirm these results using objective measurements of sleep and weight status.

The association found between sleeping less than the recommended number of hours and risk for obesity has important clinical implications for Island PR youth. These results suggest that interventions should focus on decreasing depressive/anxiety symptoms and/or enhancing sleep behaviors in this group, as a means to potentially decrease obesity risk. A sleep evaluation assessing the sleep environment (e.g., consistent sleep location), sleep practices (e.g., whether the child has a consistent bedtime and wake-up time), and sleep hygiene (e.g., sleep disruptions in the child's bedroom) can be integrated into assessments for children and adolescents who are identified in clinical settings as at risk for being overweight or obese, especially since both maladaptive sleep behaviors and weight conditions can be prevented and treated. Further, focusing on enhancing physical activity to enhance mood, and to enhance sleep, may be an important modifiable target for intervention with Island PR children at risk for obesity. Finally, more research examining cultural-related beliefs about sleep and physical activity as well as healthy eating is needed in Island PR children at higher risk for less optimal sleep patterns and obesity (Boergers & Koinis-Mitchell, 2010).

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Table 1

Family Demographics and Youth Characteristics by Obese and Non-Obese Youth

	Obese [n=85]			Non Obese [n=294]		
	n	%	Mean[95% CI]	n	%	Mean[95% CI]
Income						
6,000 or less	17	27.03	[16.9, 40.29]	60	18.21	[13.40, 24.26]
6,001 – 12,000	21	23.80	[15.02, 35.57]	60	23.57	[18.16, 30.02]
12,001 – 25,000	25	26.66	[17.73, 38.00]	73	28.10	[22.49, 34.50]
25,001 or more	18	22.51	[13.15, 35.80]	76	30.1.1	[23.63, 37.50]
Perception of Poverty						
Live well	45	58.17	[45.03, 70.25]	152	53.52	[46.92, 59.99]
Check to Check	32	35.82	[24.53, 48.92]	108	38.36	[31.41, 45.83]
Live poorly	8	6.01	[2.88, 12.12]	32	8.12	[5.60, 11.63]
Household composition	85	4.33	[4.01, 4.65]	294	4.12	[3.97, 4.27]
Youth Characteristics						
Male *	51	62.31	[50.16, 73.09]	145	47.37	[40.59, 54.25]
Female	34	37.69	[26.9, 49.8]	149	52.63	[45.75, 59.40]
Age	85	14.56	[13.93, 15.19]	294	15.27	[14.92, 15.62]
Hours of Sleep						
Recommended # of hrs.	44	49.34	[37.36, 61.40]	192	67.48	[61.00, 73.35]
Sleeping less than 7 hrs. *	14	23.50	[13.85, 36.99]	32	11.57	[8.06, 16.33]
Sleeping 10 or more hrs	26	27.16	[18.27, 38.34]	70	20.95	[16.55, 26.17]
Child's Asthma						
Yes *	49	45.8	[34.05, 58]	128	31.4	[26.26, 37.1]
No	36	54.2	[41.97, 65.95]	164	68.6	[62.9, 73.7]

	Obese [n=85]			Non Obese [n=294]		
	n	%	Mean[95% CI]	n	%	Mean[95% CI]
Child Physical Activities						
Do not meet guidelines	65	77.3	[64.7, 86.3]	218	74.0	[67.6, 79.6]
Meets guidelines	18	22.7	[12.7, 35.3]	74	25.9	[20.4, 32.4]
Adult caretaker obesity						

	Obese [<i>n</i> =85]		Non Obese [<i>n</i> =294]	
	<i>n</i>	%	<i>n</i>	%
Obese *	48	58.1	86	30.1
		[44.9, 70.2]		[24.1, 36.9]
Non-obese	36	41.9	198	61.9
		[29.8, 55.1]		[63.0, 75.9]
BMI				
Underweight		–	12	3.48
				[1.90, 6.30]
Healthy weight		–	215	73.68
				[67.24, 79.25]
Overweight		–	67	22.84
				[17.51, 29.22]
Obese	85	100.00		–
Depressive/Anxiety Disorder [DISC Combined Algorithm]	28	32.13	60	16.15
		[21.75, 44.63]		[12.12, 21.19]

Note: Statistical significance was ascertained using either the Chi-Square test statistic for categorical outcomes or the *t* statistic for continuous measures. A total of *n*=57 subjects were omitted from this table due to missing data on variables used to estimate the youth's obesity status.

* *p* < .05

Table 2

Regression Models to Predict Obesity Status (BMI cut-off scores)

Predictors	OR [95% CI]	Prevalence Risk Ratio [95% CI]	<i>t</i> (<i>df</i> =235)	<i>p</i> -value
Model 1a and 1b: Simple Logistic Regressions^A				
Sleeping < 7 hours	2.84 [1.22, 6.58]	2.18 [1.21, 3.92]	2.44	.0156
Sleeping 10 hours	1.80 [0.96, 3.38]	1.59 [0.98, 2.59]	1.83	.0687
Depressive/Anxiety disorder	2.46 [1.29, 4.69]	1.94 [1.23, 3.05]	2.75	.0065
Model 2: Multivariate Logistic Regressions Unadjusted for Covariates^A				
Sleeping < 7 hours	2.32 [1.01, 5.33]	1.86 [1.03, 3.36]	1.99	.0482
Sleeping 10 hours	1.73 [0.92, 3.28]	1.53 [0.94, 2.47]	1.70	.0904
Depressive/Anxiety disorder	2.23 [1.16, 4.29]	1.79 [1.13, 2.84]	2.42	.0162
Model 3: Multivariate Logistic Regression Adjusted for Covariates^B				
Sleeping < 7 hours	3.02 [1.27, 7.22]	2.06 [1.22, 3.47]	2.50	.0130
Sleeping 10 hours	1.72 [.85, 3.50]	1.46 [.90, 2.38]	1.52	.1311
Depressive/Anxiety Disorder	1.75 [0.79, 3.91]	1.45 [0.86, 2.46]	1.38	.1677
Child Gender	1.75 [0.93, 3.32]	1.47 [0.94, 2.31]	1.74	.0837
Child Physical Activity	1.27 [0.60, 2.69]	1.18 [0.70, 1.99]	0.63	.5289
Adult Caretaker Obese	3.46 [1.76, 6.82]	2.40 [1.48, 3.87]	3.61	.0004
Child's Asthma	1.97 [0.11, 3.51]	1.58 [1.06, 2.35]	2.32	.0209

Note:

^A Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 376 subjects.

^B Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 363 subjects. Due to the estimation method, degrees of freedom for an analysis conducted with survey samples obtained by cluster sampling are a function of the number of clusters and sampling strata, not the number of individual subjects in the sample. Prevalence risk ratio was estimated by the ratio of the predicted marginals obtained from a particular regression model for each group of a categorical covariate. Reference group for hours of sleep is sleeping 7 to 9 hours, normal recommended sleep.

Table 3

Regression Models to Predict Obesity Status (BMI percentiles)

Predictors	b [95% CI]	M _p [95% CI]	t (df=235)	p-value
Model 1a and 1b: Simple Linear Regressions^A				
Sleeping 7 to 9 hours	0.00	65.6 [61.5, 69.7]		
Sleeping <7 hours	10.3 [1.03, 19.49]	75.9 [67.5, 84.2]	2.19	.0295
Sleeping 10 hours	3.65 [-3.7, 11.0]	69.3 [62.8, 75.6]	0.98	.3295
Depressive/Anxiety disorder				
Non-Depression	0.00	67.1 [63.3, 70.9]		
Depressed	5.34 [-2.33, 13.00]	72.4 [65.7, 79.0]	1.37	.1714
Model 2: Multivariate Linear Regression Unadjusted for Covariates^A				
Sleeping 7 to 9 hours	0.00	65.1 [62.1, 70.1]		
Sleeping <7 hours	9.09 [-0.46, 18.65]	75.2 [66.5, 83.8]	1.88	.0620
Sleeping 10 hours	3.37 [-3.96, 10.70]	69.3 [63.1, 71.2]	0.91	.3659
Depressive/Anxiety disorder				
No-Disorder	0.00	67.4 [63.4, 71.22]		
Disorder Present	3.96 [-3.78, 11.70]	71.3 [64.7, 77.9]	1.01	.3142
Model 3: Multivariate Linear Regression Adjusted for Covariates^B				
Sleeping 7 to 9 hours	0.00 [0.00, 0.00]	65.6 [61.8, 69.5]		
Sleeping < 7 hours	11.5 [2.43, 19.87]	76.8 [69, 84.5]	2.50	.0125
Sleeping 10 hours	3.7 [-3.4, 10.9]	69.3 [63.3, 75.4]	1.02	.3061
Depressive/Anxiety Disorder				
Non-Depression	0.00	67.9 [64.4, 71.5]		
Depressed	0.80 [-7.1, 8.7]	68.7 [61.8, 75.6]	0.06	.8421
Child's Gender				
Female	0.00	65.0 [60.7, 69.3]		
Male	6.14 [-.02, 12.3]	71.1 [66.7, 75.6]	1.97	.0507
Child Physical Activity				
Do not meet guidelines	0.00	69.3 [65.8, 72.8]		
Meets guidelines	-4.94 [-12.7, 2.7]	64.3 [57.6, 71.1]	1.27	.2034
Adult Obesity				
Non-Obese	0.00	63.8 [59.6, 68.0]		
Obese	11.59 [5.1, 18.1]	75.4 [70.7, 80.2]	3.52	.0005
Child's Asthma				
No Asthma	0.00	65.5 [61.5, 69.4]		
Asthma	7.43 [1.88, 13.0]	72.9 [68.6, 77.2]	2.56	.0089

Note.

^A Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 376 subjects.^B Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 363 subjects. Due to the estimation method, degrees of freedom for an analysis conducted with survey samples obtained by cluster sampling are a function of the number of clusters and sampling strata, not the number of individual subjects in the sample. M_p=Predicted marginal, i.e., expected value in a regression model for a

level of a categorical variable when all the covariates are fixed at their sample value. Regression coefficients for reference level of a categorical variable are fixed to 0.00.

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Table 4

Multiple Regression for testing moderation in prediction of Obesity Status (BMI cut-off scores) using categorical depressive/anxiety diagnosis variable

Predictors	OR [95% CI]	M _p [95% CI]	t (df=235)	p-value
Model 1 using as moderator				
Depressive/anxiety disorder^A				
Sleeps 7 to 9 hours	1.00 [1.00, 1.00]	.17 [.12, .24]		
Sleeps < 7 hours	2.04 [0.64, 6.51]	.32 [.20, .48]	1.22	.2251
Sleeps 10 hours	2.02 [0.92, 4.43]	.25 [.17, .36]	1.77	.0785
Depressive/Anxiety Disorder				
Non-Depression/Anx	1.00 [1.00, 1.00]	.20 [.15, .26]		
Depressed/Anx	1.62 [0.48, 5.46]	.27 [.17, .41]	0.78	.4367
Interaction terms				
Sleeps 7 to 9 hours, No Dep/Anx	1.0 [1.00, 1.00]	.16 [.11, .23]		
Sleeps 7 to 9 hours, Yes Dep/Anx	1.0 [1.00, 1.00]	.23 [.10, .44]		
Sleeps< 7 hours, No Dep/Anx	1.0 [1.00, 1.00]	.26 [.13, .47]		
Sleeps< 7 hours, Yes Dep/Anx	2.79 [0.38, 20.65]	.57 [.33, .79]	1.01	.3131
Sleeps 10 hours, No Dep/Anx	1.00 [1.00, 1.00]	.26 [.16, .39]		
Sleeps 10 hours, Yes Dep/Anx	0.42 [0.07, 2.44]	.20 [.08, .42]	0.97	.3343

Note.

^A Due to missing data on obesity and the other covariates, the regression model was estimated with a total of $n=363$ subjects. Due to the estimation method, degrees of freedom for an analysis conducted with survey samples obtained by cluster sampling are a function of the number of clusters and sampling strata, not the number of individual subjects in the sample. Mp = Predicted marginal, i.e., the expected value of the dependent variable from a regression model for a level of a categorical variable when all the covariates have been fixed at their corresponding sample values. All covariates were included in the regression model, but to focus on the issue of moderation, the table shows only those predictors that have the direct relevance for the moderation hypothesis. Odds ratio for the reference level of categorical variable were fixed to 1.0.

Table 5

Regression Models for testing moderation in prediction of Obesity Status (BMI cut-off scores) using continuous depressive/anxiety score.

Predictors	OR [95% CI]	M _p [95% CI]	t (df=235)	p-value
Model 1 using as moderator the diagnosis of a depressive/anxiety disorder^A				
Sleeps 7 to 9 hours	1.00 [1.00, 1.00]	.17 [.11, .25]		
Sleeps < 7 hours	3.52 [0.77, 16.12]	.37 [.18, .61]	1.63	.1045
Sleeps 10 hours	2.14 [0.62, 7.37]	.28 [.15, .46]	1.21	.2275
Depressive/Anxiety Disorder				
Depressed/Anxiety	1.06 [1.00, 1.12]		2.00	.0464
Interaction Terms				
Sleeps < 7 hours by Dep/Anx	0.98 [.89, 1.07]		0.43	.6671
Sleeps 10 hours by Dep/Anx	0.98 [.89, 1.08]		0.41	.6806

Note.

^A Due to missing data on obesity and the other covariates, the regression model was estimated with a total of $n=363$ subjects. Due to the estimation method, degrees of freedom for an analysis conducted with survey samples obtained by cluster sampling are a function of the number of clusters and sampling strata, not the number of individual subjects in the sample. Mp = Predicted marginal, i.e., the expected value of the dependent variable in a regression model for a level of a categorical variable when all other covariates have been fixed at their corresponding sample values. All covariates were included in the regression model, but to focus on the issue of moderation, the table shows only those predictors that have direct relevance for the moderation hypothesis. Odds ratios for the reference level of categorical variable were fixed to 1.0.

Table 6

Multiple Regression for testing moderation in prediction of Obesity Status (BMI percentiles) using categorical depressive/anxiety diagnosis variable.

Predictors	<i>B</i> [95% <i>CI</i>]	<i>M_p</i> [95% <i>CI</i>]	<i>t</i> (<i>df</i> =235)	<i>p-value</i>
Model 1 using as moderator a depressive/anxiety disorder^A				
Sleeps 7 to 9 hours	0.00 [0.00, 0.00]	65.6 [61.7, 69.4]		
Sleeps < 7 hours	11.23 [1.27, 21.18]	76.9 [69.1, 84.5]	2.72	.0272
Sleeps 10 hours	2.56 [-5.42, 10.54]	69.5 [63.4, 75.6]	0.63	.5278
Depressive/Anxiety Disorder				
Non-Depression/Anx	0.00	67.9 [64.4, 71.5]		
Depressed/Anx	-0.78 [-11.9, 10.3]	68.9 [61.8, 75.6]	0.14	.8903
Interaction terms				
Sleeps 7 to 9 hours, No Dep/Anx	0.00 [0.00, 0.00]	65.7 [61.5, 69.9]		
Sleeps 7 to 9 hours, Yes Dep/Anx	0.00 [0.00, 0.00]	64.9 [54.8, 75.1]		
Sleeps < 7 hours, No Dep/Anx	0.00 [0.00, 0.00]	76.9 [67.8, 86.1]		
Sleeps < 7 hours, Yes Dep/Anx	0.58 [-19.6, 20.7]	76.7 [62.7, 90.7]	0.06	.9549
Sleeps 10 hours, No Dep/Anx	0.00 [0.00, 0.00]	68.3 [61.4, 75.2]		
Sleeps 10 hours, Yes Dep/Anx	7.2 [-9.24, 23.6]	74.7 [64.4, 84.9]	0.86	.3899

Note.

^A Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 363 subjects. All covariates were included in the regression model, but to focus on the issue of moderation, the table shows only those predictors that have direct relevance for the moderation hypothesis. Regression coefficients for reference level of a categorical variable are fixed to 0.00.

Table 7

Multiple Regression for testing moderation in prediction of Obesity Status (BMI percentiles) using continuous total depressive anxiety symptoms severity level score.

Predictors	<i>b</i> [95% CI]	<i>M_p</i> [95% CI]	<i>t</i> (<i>df</i> =235)	<i>p</i> -value
Sleeps 7 to 9 hours ^A	0.00 [0.00, 0.00]	65.7 [61.85, 69.6]		
Sleeps < 7 hours	13.23 [4.82, 21.64]	78.7 [71.1, 86.2]	3.10	.0022
Sleeping 10 hours	3.54 [-3.57, 10.6]	69.4 [63.4, 75.5]	0.98	.3276
Depressive/Anxiety				
Depressive/Anxiety symptoms	0.14 [-0.35, 0.64]	68.4 [65.2, 71.6]	0.56	.5729
Interaction terms				
Sleeps < 7 hours by Dep/Anx	-0.57 [-1.52, 0.40]	78.9 [71.2, 86.6]	1.16	.2483
Sleeps 10 hours by Dep/Anx	0.24 [-1.53, 0.39]	69.2 [63.1, 75.3]	0.51	.6094

Note. Due to missing data on obesity and the other covariates, the regression model was estimated with a total of *n*= 363 subjects.

^A Reference group. All covariates were included in the regression model, but to focus on the issue of moderation, the table shows only those predictors that have direct relevance for the moderation hypothesis. Regression coefficients for reference level of a categorical variable are fixed to 0.00.