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Impact of Conjoint Trajectories of Body Mass Index and Marijuana Use on Short Sleep Duration

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Abstract

Background and Objectives—We examined the association between the conjoint developmental trajectories of body mass index (BMI) and marijuana use from age 24 to age 32 and short sleep duration.

Methods—The participants included 158 African American male, 267 African American female, 166 Puerto Rican male, and 225 Puerto Rican female young adults (N=816). Using Mplus, we obtained the conjoint trajectories of BMI and marijuana use. Logistic regression analyses examined the association between the conjoint trajectories and short sleep duration.

Results—Five conjoint trajectory groups were extracted: normal BMI and no or low marijuana use, obese and no or low marijuana use, morbidly obese and some marijuana use, normal BMI and high marijuana use, and obese and high marijuana use. Those in the obese and no or low marijuana use group, the morbidly obese and some marijuana use group, and the obese and high marijuana use group were more likely to report shorter sleep duration than those with normal BMI and no or low marijuana use group.

Conclusions and Scientific Significance—This study highlights the significance of examining joint trajectories over several developmental stages. In treating short sleep duration, we propose focusing on treating obesity, and also treating marijuana use if applicable.

Background and Objectives

In the last decade, evidence has increased that short sleep duration impacts physical health. Short sleep duration has been defined as less than or equal to 5 hours of sleep per night.¹ Short sleep duration may interfere with immune functioning² and the regulation of hunger.³ Short sleep duration also has an effect on cognitive functioning including psychomotor and cognitive speed, vigilance and executive attention, working memory, and higher cognitive

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Declaration of Interests

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

abilities.⁴ Since short sleep duration has an adverse impact on health, it is important to examine its predictors. One factor that has been linked with short sleep duration is obesity.⁵

Obesity has become a major health problem worldwide.⁶ Much research suggests that obesity as defined by body mass index (BMI) has adverse health consequences and is related to physical morbidity.⁷ Several investigators have reported that shorter sleep duration is related to greater obesity.^{5,8} In several cross-sectional and longitudinal studies, short sleep duration was associated with higher body weight.^{9,10} However, Patel and colleagues⁸ did not find a linear relation between short sleep duration and higher weight in women. Hasler and colleagues¹¹ reported a significant positive association between earlier obesity and later short sleep duration. To our knowledge, there is a dearth of research pertaining to the relationship of the trajectories of obesity and/or BMI and short sleep duration.

Marijuana use has also been linked to short sleep duration.¹² Glozier et al.¹² found that marijuana users are more likely to report shorter sleep duration. However, Bolla et al.¹³ reported no differences between marijuana users and non-users on the frequency of short sleep. Given this disparity in the research findings, our study examines this relationship further.

Since BMI and marijuana use differ at different developmental stages, it is important to understand how both BMI and marijuana use change with age. Studies have examined the variation in body composition associated with age.^{14,15} According to Meeuwse and colleagues,¹⁵ BMI progressively increased with age. Several studies of marijuana use have found periods of peak use, typically in late adolescence and early adulthood (twenties).¹⁶ While many individuals decrease their marijuana use from the early twenties to the early thirties,¹⁶ some individuals continue using the same amount or even increase their marijuana use into their thirties.¹⁷

Marijuana use has been reported to stimulate appetite and increasing appetite may lead to weight gain.¹⁸ To date, however, there have been no studies that examine the conjoint trajectories or patterns of change of BMI and marijuana use as related to short sleep duration. The present study examines how BMI and marijuana use interact with each other and relate to short sleep duration. Operating within a developmental framework, we examine the conjoint trajectories of BMI and marijuana use from ages 24 to 32 as related to short sleep duration at age 32. Examining the trajectories of BMI and marijuana use jointly over 8 years affords a more complete understanding of the predictors of short sleep duration than the study of each component separately.

Hasler et al.¹¹ found that on average, lower socioeconomic status (SES) individuals are more likely to report short sleep duration than higher SES individuals. They also found that males were more likely to report short sleep duration than females. With regard to ethnicity, African Americans have a higher rate of diagnosed sleep apnea than Hispanics.¹⁹ High levels of stress have also been associated with less sleep.²⁰ Consequently, we controlled for these possibly confounding variables, namely, the level of education (SES), gender, ethnicity, and the level of work stress of this study's participants.

The present study has several innovative aspects. First, this developmental period (i.e., ages 24–32) is significant because it usually involves the assumption of multiple new roles: the establishment and maintenance of a relationship with a partner, becoming a parent, and entering the workforce. Employers often discriminate against hiring obese adults and marijuana users.^{21,22} Second, the developmental conjoint trajectories of BMI and marijuana use are examined over time from emerging adulthood (mean age of 24) to adulthood (mean age of 32). Third, comparisons of pairs of trajectories of BMI and marijuana use are able to predict short sleep duration. Fourth, this research studies an understudied and underserved population of urban African American and Puerto Rican young adults.

We hypothesize the following: (1) There will be more than one pattern of conjoint trajectories of BMI and marijuana use. (2) The trajectory of normal BMI and no or low marijuana use will be the most common. (3) The conjoint trajectory of normal BMI and no or low marijuana use in comparison to the other conjoint trajectory patterns (e.g., obesity and some marijuana use) will have a lower probability of short sleep duration. We expect that these relationships will emerge despite control on gender, ethnicity, level of education, stress at work, parental status, age of the youngest child, and number of hours at worked.

METHODS

Participants

The present analysis is based on three waves (T3, T4, and T5) of our Harlem Longitudinal Development Study. At T5, the sample included 816 urban African American and Puerto Rican young adults. We restricted our analysis to T3, T4, and T5 because only at these waves did we have BMI data. The participants' mean age at T3 (2000 – 2001) was 24.4 years (S.D. 1.3 years). At T4 (2004 – 2006), the respondents' average age was 29.2 years (S.D. 1.7 years). At T5 (2007 – 2010), the participants' average age was 32.3 years (S.D. of 1.3 years). The sample was 52% African American and 48% Puerto Rican. Forty percent of the participants were male.

The initial sample consisted of adolescents who were in grades 7–10 in schools in the East Harlem section of New York City. Trained interviewers collected the data. The Institutional Review Boards of the Mount Sinai School of Medicine and of the New York University School of Medicine approved the study's procedures. A Certificate of Confidentiality was obtained from the National Institutes of Health. Written informed assent was obtained from all participants after the procedures were fully explained.

The median educational level at T5 was the completion of one year of college. At T5, the participants' occupations were as follows: 26.6% were employed in clerical positions, 25.9% were employed in semi-skilled jobs (e.g., factory worker), 13.9% had professional level jobs, 12.0% were employed in managerial positions, 10.8% had skilled jobs (e.g., mechanic), and 10.8% were unemployed. Among those who were unemployed, 14.0% were attending school. At T5, 43.0% of the sample were single, 24.8% of the participants were cohabiting, 27.8% of the sample were married and living together, and 4.4% of the sample were married but separated. Additional information regarding the study population is available from previous reports^{23,24}.

Measures

BMI at each time wave was calculated using the participant's self-reported height and

weight, with $BMI = \frac{weight(kg)}{height^2(m)}$. The categories for BMI include the following: normal BMI if BMI is greater than or equal to 18.5 and less than 25, overweight if BMI is greater than or equal to 25 and less than 30, obese if BMI is greater than or equal to 30 and less than 35, and morbidly obese if BMI is greater than or equal to 35.

Marijuana use at each time wave was assessed by asking the participant "how often have you used marijuana in the past year?" The answer options were never (0), a few times a year or less (1), about once a month (2), several times a month (3), and once a week or more (4).

Short sleep duration at T5 was assigned a score of 1 if the participant reported sleeping on average less than or equal to 5 hours per night and 0 otherwise.¹

The control variables are described in Table 1.

Among the 13 variables described above and in Table 1, 44% of the participant values were missing for the age of the youngest child at T4 as they did not have children. Thirty three percent were missing for 3 variables (namely, BMI at T3, Marijuana use at T3, and stress at work at T3). This occurred because budget constraints limited the T3 sample to 660 participants. Twelve percent or less were missing for 2 variables (BMI at T4 and Marijuana use at T4), 11 percent were missing for 2 variables (educational level at T4 and the number of hours worked at T4), and .01% or less were missing on the remaining 5 variables. We applied the full information maximum likelihood approach for missing data.²⁵

Analytic Plan

We used Mplus²⁵ to obtain the conjoint trajectories of BMI and marijuana use, a mixture modeling process. BMI and marijuana use at each point in time were treated as censored normal variables. The Mplus software accommodates censoring. We used the Bayesian information criterion to determine the number of trajectory groups. Each participant was assigned to the trajectory group with the largest Bayesian posterior probability. The observed trajectories for each of the groups in Figure 1 were the averages of BMI and marijuana use at each point in time for the participants assigned to that group.

We then conducted logistic regression analyses using SAS²⁶ to examine the association between the conjoint trajectories of BMI and marijuana use and short sleep duration. The Bayesian posterior probabilities of the conjoint trajectories of BMI and marijuana use were the independent variables. T5 short sleep duration was the dependent variable. Gender, ethnicity, T3 stress at work, educational level at T4, parental status at T4, age of the youngest child at T4, and number of hours worked at T4 were statistically controlled in the analyses.

RESULTS

The mean and standard deviation (SD) of BMI at each wave were 26.1 (4.8), 28.5 (6.4), and 29.3 (6.8) for T3–T5, respectively. Similarly, the mean (SD) marijuana use scores at T3–T5 were 0.89 (1.4), 0.72 (1.4), and 0.89 (1.4), respectively. One hundred and seventy-two (27.3%) participants reported short sleep duration at T5. Finally, at T5 there was an association between greater BMI (obese compared to normal) and higher marijuana use (a few times a year or more compared to less than a few times per year) ($\chi^2=32.05$, $df=1$, $p<.001$).

A five-group model was selected, based on the Bayesian information criterion and the requirement that the group size of each group be at least 5%. The Bayesian information criteria were 17687, 17239, 17051, 16872, and 16713 for a 2, 3, 4, 5, and 6-group model, respectively. Although the 6-group model had the smallest Bayesian information criterion score, one of the groups had a prevalence of 0.6%. Hence, we selected the five group model. Figure 1 presents the observed trajectories and the percentages for each of the five trajectory groups. The mean Bayesian posterior probability of the participants who were assigned to the corresponding groups ranged from 86% to 93%, which indicated a good classification.

The five conjoint trajectory groups were named: 1) normal BMI and no or low marijuana use (41%, mean Bayesian posterior probability =93%), 2) obese and no or low marijuana use (21%, mean Bayesian posterior probability =86%), 3) morbidly obese and some marijuana use (8%, mean Bayesian posterior probability =91%), 4) normal BMI and high marijuana use (17%, mean Bayesian posterior probability =90%), and 5) obese and high marijuana use (13%, mean Bayesian posterior probability =88%). BMI increased between the ages of 24 and 32 for each conjoint trajectory. There were 6 individuals who had below normal BMI (ranged from 16.3 to 18.4); 1 individual was assigned to the normal BMI and none or low marijuana use group, and 5 individuals were assigned to the normal BMI and high marijuana use group. In three groups, the marijuana use trajectory was either stable or decreased slightly between ages 24 and 32. Two groups (normal BMI and high marijuana use, obese and high marijuana use) representing 30% of the participants increased their marijuana use between 24 and 32 years of age. Table 2 presents the summary statistics for each conjoint trajectory group and comparison tests between the groups. Females were more likely to be in the groups of normal BMI/no or low marijuana use, obese/no or low marijuana use, and morbidly obese/some marijuana use than in the other conjoint trajectory groups. The participants who engaged in postgraduate education, and who had at least 1 child were more likely to be in the normal BMI/no or low marijuana use group than the other conjoint trajectory groups.

Table 3 shows the adjusted odds ratios (AOR) for short sleep duration when gender, ethnicity, T3 stress at work, and educational level, parental status, age of the youngest child, and number of hours worked all at T4 were controlled in the logistic regression analyses. The reference variable is the Bayesian posterior probability of the normal BMI/no or low marijuana use group. We compared the Bayesian posterior probability of the participants in each of the other groups with the Bayesian posterior probability of the normal BMI and no or low marijuana use group. The participants in the obese/no or low marijuana use group

(AOR=2.40, $p<.05$), the obese/high marijuana use group (AOR= 2.82, $p<.05$), and the normal BMI/high marijuana use group (AOR=3.21, $p<.05$) were more likely to report shorter sleep duration at T5 than the normal BMI/no or low marijuana use group. The AOR for the morbidly obese/some marijuana use group compared to the reference group with regard to the likelihood of short sleep duration was 2.21, which is not statistically significant.

DISCUSSION

We examined the developmental course of the conjoint trajectories of BMI and marijuana use from emerging adulthood to adulthood, and identified short sleep duration as an outcome associated with these conjoint trajectories as noted below. To our knowledge, this is the first study to examine the relationship of the conjoint trajectories of BMI and marijuana use to short sleep duration.

With one exception, our hypotheses were supported: (1) The trajectory analysis yielded five conjoint trajectories of BMI and marijuana use. (2) The group characterized by normal BMI and no or low marijuana use was the most common (41%) trajectory group. (3) Two of the trajectory groups including the obese and one with normal BMI had a higher likelihood of short sleep duration than did the group with normal BMI and no or low marijuana use. The remaining trajectory group comparison did not show a significant difference on short sleep duration, possibly because the morbidly obese and some marijuana use group included only 8% of the sample.

This study's no or low marijuana users who had normal BMI had the lowest prevalence of short sleep duration, 22%. The prevalence of short sleep duration in the other trajectory groups was approximately 30%. Hence, higher BMI or marijuana use or both were associated with a greater likelihood of short sleep duration. These results are in accord with Glozier et al.'s¹² finding that those reporting high marijuana use were more likely to report short sleep duration. They are also consistent with Seegers et al.⁵ who reported that shorter sleep duration is related to greater obesity. Consequently, it is important to address both marijuana use and obesity among those experiencing short sleep duration.

In addition to our major findings, our results indicate that all of the trajectories show that BMI increased with age. Indeed, 3 of the 5 trajectories showed obesity starting at age 24 and increasing subsequently. This concurs with the results of Meeuwssen et al.¹⁵ who reported that BMI increased with age. From a public health perspective, this association suggests that focusing on BMI at younger developmental stages may be warranted.

Regarding marijuana use, this study showed that 70% of the participants were in trajectories that showed marijuana use decreasing with age. However, about 30% were in the trajectory groups that showed marijuana use increasing with age. These findings accord with those of investigators reporting that while many individuals decrease their marijuana use from the mid twenties to the early thirties,¹⁶ some show stable or increased marijuana use into their thirties.¹⁷ According to Bachman et al.,¹⁶ some older adults are more likely to use drugs as a result of having a more unconventional life style.

The combination of obesity and marijuana use may lead to discrimination and stigma which can be deeply distressing and ultimately result in short sleep duration.^{22,23} Moreover, the negative effect of this combination on health and quality of life might be particularly stressful,^{23,27} thus interfering with sleep. However, stress does not fully account for the relationships because the associations generally remained significant when we controlled for T3 stress at work.

Obesity and marijuana use combined may also lead to difficulties in relationships with family members or peers, and ultimately short sleep duration. According to Carr and Friedman,²⁸ obese individuals report significantly less support from family members. Furthermore, Ahern et al.²² found that drug users reported more rejection from family and peers because of their drug use. These mechanisms provide possible explanations for why marijuana users have an increased likelihood of reporting short sleep duration when they are obese.

Obesity is related to psychological and hormonal, or neurophysiological factors, which in turn, are related to short sleep duration. Psychological factors include depression or bipolar disorders.²⁹ In addition, Kaneita et al.³⁰ found that those reporting greater depression demonstrate shorter sleep duration. Consequently, obese individuals may be more depressed, which in turn, is associated with short sleep duration.

Physiological factors may also mediate the relationship between obesity and short sleep duration. These physiological factors include sleep-related breathing problems (e.g., sleep apnea) and diabetes.³¹ Obesity is related to diabetes,³² which in turn, has been found to be associated with short sleep duration.³³

Limitations of this Study

Data are based on self-report measures and were not verified by information from additional sources. However, studies have shown that self-report data can yield reliable results.³⁴ Patel and colleagues,³⁵ in their prospective study, found that self-reported sleep duration was stable over a two-year period. In addition, Glozier et al.¹² concluded that the expense and logistic burdens of actigraphy necessitate relying on self report measures of sleep duration. The sleep duration data might be more robust if it included separate measures of hours of sleep during the week and on the weekend. People may compensate for less sleep duration during the week by sleeping longer on the weekend. Other factors may underlie the relationship between conjoint trajectories of marijuana use and BMI and short sleep duration, although the relationship was maintained with control on gender, ethnicity, T3 stress at work, T4 educational level, T4 parental status, T4 age of the youngest child, and T4 number of hours worked. Future studies should explore other areas of physical and psychological stress, in addition to stress at work, which may affect the associations of the conjoint trajectories of BMI and marijuana use with short sleep duration. Additionally, since one trajectory group had an estimated prevalence of less than 10%, the power of one analysis may be relatively low. Possibly long term marijuana use alone or in combination with short sleep duration may increase body weight. Indeed, Gangwisch et al.³⁶ present data supporting inadequate sleep as a risk factor for obesity. Hence there may be a reciprocal relationship between marijuana use, obesity, and short sleep duration. We wanted to control

for T2 sleep duration, but this data was not available. Since stress at work is related to sleep duration,³⁷ we used it as a proxy control. Future research should include controls for earlier measures of sleep duration. Lastly, this study's findings cannot be generalized beyond urban African Americans and Puerto Ricans until the findings are replicated using a sample from different ethnic or cultural groups.

Conclusions, Scientific Significance and Future Directions

The simultaneous consideration of the conjoint trajectories of obesity and marijuana use in relation to short sleep duration was innovative. Additionally, the urban sample was community-based, and the research was longitudinal, covering a 10-year period. The public health implications of the findings suggest that long-term obesity, independent of marijuana use, and marijuana use, independent of obesity are related to short sleep duration and of concern. Further, obesity combined with high marijuana use may interfere with sleep.

Thus we have identified two aspects of a health compromising life style, obesity and marijuana use. These two aspects are related over time and accord with the work of van Nieuwenhuijzen et al.³⁸ Their research found that obesity clustered with other health related variables while marijuana use clustered more strongly with delinquent or problem behavior. Among adults these clusters were strongly associated.

Overall, the findings suggest that prevention and treatment of obese individuals reporting short sleep duration might be more effective if their marijuana use was also addressed. Further research is required to explicate the biological and psychological mechanisms, discussed above, that intervene between obesity and marijuana use, and short sleep duration. Future studies might also assess the role of short sleep duration as a predictor of conjoint trajectories of obesity and marijuana use.

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Figure 1.

Trajectories of Body Mass Index and Marijuana Use by Conjoint Trajectory Group^{a,b,c,d}

^aThe percentage of participants who reported short sleep duration in the normal BMI and no or low marijuana use group was 22%; in the obese and no or low marijuana use group was 33%; in the morbidly obese and some marijuana use group was 32%; in the normal BMI and high marijuana use group was 30%; and in the obese and high marijuana use group was 28%.

^bThe categories for BMI include the following: normal BMI if $18.5 \leq \text{BMI} < 25$, overweight if $25 \leq \text{BMI} < 30$, obesity if $30 \leq \text{BMI} < 35$, and morbidly obese if $\text{BMI} \geq 35$.

^cThe answer options for marijuana use were never (0), a few times a year or less (1), about once a month (2), several times a month (3), and once a week or more (4).

^dThe vertical bars in the graphs present the standard errors at each time point. The standard errors for BMI and marijuana use were: 1) 0.12 and 0.17 at age 24, 0.16 and 0.01 at age 29, and 0.17 and 0.02 at age 32 in the normal BMI and no or low marijuana use group; 2) 0.22 and 0.06 at age 24, 0.24 and 0.02 at age 29, and 0.27 and 0.01 at age 32 in the obese and no

or low marijuana use group; 3) 0.14 and 0.14 at age 24, 0.70 and 0.16 at age 29, and 0.76 and 0.14 at age 32 in the morbidly obese and some marijuana use group; 4) 0.19 and 0.1 at age 24, 0.25 and 0.13 at age 29, and 0.26 and 0.11 at age 32 in the normal BMI and high marijuana use group; 5) 0.27 and 0.16 at age 24, 0.34 and 0.17 at age 29, and 0.35 and 0.14 at age 32 in the obese and high marijuana use group.

Table 1

Measures for control variables

Variable	Answer options
Gender	1 = female, 2 = males
Ethnicity	1 = African American, 2 = Puerto Rican
T3 stress at work ^a	0 = never worked (2.75% never worked), 1 = no stress, 2 = a little, 3 = some, 4 = much, 5 = great
T4 educational level	0 = 11 th grade or less, 1 = 12 th grade or GED, 2 = business or technical school, 3 = college freshman or sophomore, 4 = college junior, 5 = college senior, 6 = postgraduate business, law, medical, masters, or doctoral program
T4 parental status	0 = no child, 1 = at least 1 child
T4 age of the youngest child	Age of the youngest child
T4 number of hours worked	1 = not working for any reason, 2 = part time, 3 = full time, 35 hours or more per week

^a An appropriate T4 measure of stress at work was not available. 38.

Table 2

Summary statistics (percentages, means, and standard deviations) and comparison tests for trajectory groups

	Normal BMI/No or low marijuana use (41%, n=332)	Obese/No or low marijuana use (21%, n=175)	Morbidly obese/Some marijuana use (8%, n=66)	Normal BMI/High marijuana use (17%, n=140)	Obese/High marijuana use (13%, n=103)	Over all (N=816)	Comparison tests
Gender							
Females	68%	64%	74%	41%	46%	60%	$\chi^2(4)=44.8$
Males	32%	36%	26%	59%	54%	40%	
Ethnicity							
AA ^a	53%	48%	58%	51%	53%	52%	$\chi^2(4)=2.3$
PR ^b	47%	52%	42%	49%	47%	48%	
Stress at work at T3 ^c	1.8 (0.9)	1.7 (0.9)	1.6 (0.9)	1.7 (0.8)	1.6 (0.8)	1.7 (0.9)	$F(4)=0.5$
Educational level at T4 ^d	2.8 (1.9)	2.3 (1.8)	2.0 (1.9)	2.2 (2.0)	2.1 (2.0)	2.5 (1.9)	$F(4)=5.0$ ***
Parental status at T4 ^e							
0	44%	40%	39%	57%	37%	44%	$\chi^2(4)=13.6$ **
1	56%	60%	61%	43%	63%	56%	
Age of the youngest child at T4	4.6 (3.6)	4.8 (3.2)	5.1 (3.1)	5.2 (3.4)	5.8 (4.6)	4.9 (3.6)	$F(4)=1.4$
Number of hours worked at T4 ^f	2.7 (0.7)	2.6 (0.8)	2.5 (0.8)	2.6 (0.8)	2.5 (0.8)	2.6 (0.7)	$F(4)=1.6$
BMI ^g at T5	25.4 (3.0)	34.0 (3.5)	44.0 (6.2)	24.1 (3.1)	31.5 (3.5)	29.3 (6.8)	NA
Marijuana use at T5	0.1 (0.3)	0.03 (0.2)	0.6 (1.1)	2.9 (1.3)	2.4 (1.4)	0.9 (1.4)	NA
Short sleep duration at T5	22%	33%	32%	30%	28%	27%	$\chi^2(4)=7.9$ †

^a AA = African American^b PR = Puerto Rican^c Stress at work at T3: 0 = never worked, 1 = no stress, 2 = a little, 3 = some, 4 = much, 5 = great^d Educational level at T4: 0 = 11th grade or lower; 1 = 12th grade or GED; 2 = business or technical school; 3 = college freshman or sophomore; 4 = college junior, 5 = college senior, and 6 = postgraduate business, law, medical, masters, or doctoral program^e Parental status at T4: 0 = no child; 1 = at least 1 child^f Number of hours worked at T4: 1 = not working for any reason; 2 = part time; 3 = full time (35 hours or more per week)^g BMI = Body Mass Index

$p < 0.001$

 $p < 0.01$
**
 $p < .1$
†

Table 3

Adjusted odds ratios (95% confidence interval) of the conjoint trajectories of body mass index (BMI)^a and marijuana use compared with the normal BMI and none or low marijuana use group to predict short sleep duration^b

Conjoint Trajectories	Adjusted odds ratios for short sleep duration at Time 5
Obese and no or low marijuana use compared to Normal BMI and none or low marijuana use	2.40 * (1.08, 5.32)
Morbidly obese and some marijuana use compared to Normal BMI and no or low marijuana use	2.21 (0.79, 6.13)
Obese and high marijuana use compared to Normal BMI and no or low marijuana use	2.82 * (1.20, 6.59)
Normal BMI and high marijuana use compared to Normal BMI and no or low marijuana use	3.21 * (1.29, 8.01)

Note.

* $P < .05$ (two tailed test)

^aThe categories for BMI include the following: normal BMI if $18.5 \leq \text{BMI} < 25$, overweight if $25 \leq \text{BMI} < 30$, obesity if $30 \leq \text{BMI} < 35$, and morbidly obese if $\text{BMI} \geq 35$.

^bGender, ethnicity, stress at work at T3, educational level at T4, parental status at T4, age of the youngest child at T4, and number of hours worked at T4 were statistically controlled.