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Sleeping patterns and psychological wellbeing: Evidence from young adults in the United States

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Abstract

One in every six U.S. adults suffers from mental health problems. Mental illnesses, as measured in disability-adjusted life years, account for nearly 6.2% of the total disease burden worldwide and are considered to be one of the leading causes of death by injury, second only to road accidents. For the year 2010 alone, the estimated global direct and indirect economic cost of mental illnesses was reported to be US$2.5 trillion and this is expected to double by 2030. With a "*20% increase in service coverage for severe mental disorder*", suggested by the World Health Assembly by the year 2020 for the WHO Member states, examining alternative behavioral changes to reduce mental health problems are worth examining. Using the detailed National Longitudinal Study of Adolescent Health dataset and applying a wide range of econometric techniques we study the causal impact of sleeping pattern on various subjective wellbeing indicators among young U.S. adults. We find robust evidence that individuals who sleep for atleast 6 hours have improved mental health and are less likely to have suicidal thoughts. Additionally, our estimates highlight that those who sleep early have better mental health and reduced probability of having suicidal thoughts or going to a counselor. Waking up early is also found to result in better physical health and lower probability of having suicidal thoughts.

Keywords: sleep pattern, general and mental health, suicidal thoughts.

JEL Classification: I10, I12, I18

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1. Introduction

Approximately, 300 million people suffer from depression worldwide, with more women being affected than men (WHO, 2017b). Moreover, nearly one million people commit suicide annually (WHO, 2003). In 2015, suicide was the second leading cause of death by injury after road traffic injuries, with nearly 1.5% of all deaths worldwide happening due to suicides (WHO, 2017a), thereby also making suicide one of the top 20 leading causes of death in that year. In North America alone, nearly 18.01% adults (or 43.4 million Americans), suffered from mental health problems, 16 million individuals had major depression and 9.6 million individuals reported having serious thoughts of suicide in 2017 (Mental Health in America – Adult Data, 2017). Furthermore, it is expected that more than 50% of the population in the middle- and high-income countries will suffer from at least one mental illness at some point in their life (Trautmann et al., 2016).

Trautmann et al, 2016 estimated the global direct and indirect economic cost of mental illnesses to be around US$2.5 trillion for the year 2010, with this cost expected to double by 2030. Worldwide, the cumulative economic output loss, between 2011 and 2030 from mental disorders is projected to be US$16.3 trillion, which is nearly equivalent to the economic output lost due to other non-communicable diseases such as cardiovascular diseases, cancers, respiratory diseases and diabetes (World Economic Forum, 2011). Due to the magnitude of such excessive loss expected to arise from mental illnesses, the main motivation of this paper is to examine whether a small behavioral change such as changing the sleeping pattern of an individual can help overcome mental health issues, which could eventually save millions of taxpayer's dollars.

In the behavioral and public health literature, just like physical activity (Wannamethee et al., 1998; Lordan and Pakrashi, 2014; 2015) and diet (Jacka et al., 2011; Capacci and Mazzocchi, 2011; Blanchflower et al., 2013; Mujcic, 2014; Mujcic and Oswald, 2016; Warner et al., 2017, Lalji et al., 2018), sleep is often considered to be an important determinant of good mental and physical health, affecting overall quality of life. However, a detailed discussion on healthy sleeping habits is limited. Medical literature has found an association between reduced sleep duration (and insomnia) and incidence of various health outcomes like mortality, obesity, type-

II diabetes, hypertension and so on, though clear conclusion regarding the direction of sleep duration and overall wellbeing relationship has not been made[3].

The economic literature on sleep, on the other hand, has concentrated mostly on productivity, wages, income, unemployment and cognitive performance (Biddle and Hamermesh, 1990; Kamstra, et al., 2000; Szalontai, 2006; Antillón et al., 2014; Ásgeirsdóttir and Olafsson, 2015; Gibson and Shrader, 2018; Sedigh et al., 2017). Smith (2016) used the Fatality Analysis Reporting System (FARS) data from U.S. and daylight savings time (DST) as a proxy for sleep change and reported increase in fatal automobile accidents in America due to sleep deprivation, caused by change in sleepiness behind the wheel. Sleeping habits, namely, hours of sleep, and wake up and sleep time, however, has largely remained a neglected factor in the literature, particularly in the context of physical and psychological wellbeing.

In the present paper, we use a panel dataset comprising mainly of young adults to investigate the relationship between sleep patterns (namely, optimal hours of sleep and wake up and sleep time) and different health outcomes. That is, we examine the relationship between sleep duration and pattern and various indicators of subjective wellbeing — general health, mental health, probability of having suicidal thoughts and going for counseling — for young U.S. adults using the third and fourth round of the National Longitudinal Study of Adolescent Health (Add Health). First, we examine the optimal sleep duration that maximize subjective wellbeing. Then, we investigate whether specific sleeping pattern captured via sleep time and wake up time matter for subjective wellbeing of individuals. In addition to the individual level fixed effect model, using the propensity score matching technique, instrumental variable approach and a series of sensitivity analyses we are able to establish that there indeed exists a causal relationship between sleep patterns and subjective wellbeing.

The overall results presented in this paper suggest that both hours of sleep as well as wake up and sleep time matter for physical as well as psychological wellbeing of an individual. At least six hours of sleep is recommended. Individuals who sleep for at least 6 hours have been found to have improved mental health and are less likely to have suicidal thoughts. Moreover, it is advisable to sleep early and wake up early as our estimates highlight that those who sleep early have better mental health and reduced probability of having suicidal thoughts or going to a counselor, while waking up early is found to result in better physical health and a lower probability of having suicidal thoughts. The overall results presented in this paper may

[3] For a detailed discussion of the importance of sleep in the medical literature, see Watson et al., 2015.

therefore highlight to the government that a strong causal relationship exists between sleep duration and pattern and health outcomes of young U.S adults and could eventually lead to a straightforward policy recommendation to address the mental health epidemic in a cost-effective manner.

The current paper is organized as follows; while Section 1 discussed the importance of sleep in the context of health and identified the major gaps in the literature. The next section presents a brief discussion of the data and the variables used in the analysis. This is followed by a discussion of the empirical methodologies employed and the results in Sections 3 and 4 respectively. Finally, we conclude the paper.

2. Data

The National Longitudinal Study of Adolescent Health (also referred to as Add Health) is a nationally representative longitudinal study that started collecting information on students studying in grades 7 to 12 from 80 high schools[4] in the United States in 1994-95 in an endeavor to study the effects of multiple contexts (like family situation, school environment, peer networks, spatial networks and genetic pairs) on adolescent health and health behavior[5]. The same students were followed through adolescence and were eventually tracked through their transition into adulthood by re-interviewing them again in 1996 (wave-II), 2001-02 (wave-III) and then during 2008-09 (wave-IV). The cohort was in the age group 18-27 years in wave-III and was about 25-34 years old during wave-IV. From wave-II onwards, Add Health adopted the audio-computer assisted self-interview (ACASI) technology making it the first national study to use ACASI technology for an adolescent population, giving respondents an option to submit their responses to sensitive material in privacy. The survey module is diverse and varies from basic demographic information to questions related to relationships with family and friends, general and mental health, lifestyle choices, health risky behaviors, detailed daily activities undertaken, personality traits and access to health services. For the purpose of our analysis, we are particularly interested in two questions that are available only in the "*Sleep Pattern Module*" of wave-III and wave-IV, namely, *"On the days you go to work, school or similar activities, what time do you usually wake up?*" and "*On those days, what time do you usually go to sleep the night or day before?*". From these two questions, we derived the

[4] Table 1 in the Appendix shows the demographic details of the high schools which have participated in the Add Health survey. However, by wave-III and IV, individuals had finished with their schooling.

[5] The sample was selected by "systematic sampling method and implicit stratification", which "ensured this sample is representative of US schools with respect to region of country, region, school size, school type, and ethnicity". Retrieved from https://www.cpc.unc.edu/projects/addhealth/faqs/index.html#how-do-i-briefly

respondent's self-reported hours of sleep on working days and their sleep and wake up time. We finally use an unbalanced panel dataset with 2,093 respondents from wave-III and 2,286 respondents from wave-IV.

2.1 Outcome variables

We consider four different indicators of subjective wellbeing — general health, mental health, probability of having suicidal thoughts and going for counseling — in this study. For the general health outcome variable, we use their response to the following question "*In general, how is your health?*" with response options: excellent, very good, good, fair and poor. The responses are recorded on a scale of 1 to 5, with 1 being excellent health and 5 poor health. To measure mental health, we use an 8-item[6] version of the GHQ-12 to capture the respondent's psychological wellbeing over the past one week. The 8 items used to capture mental health refer to: ability to concentrate and overcome unhappiness; on perception of others opinion of the respondent and on feelings of sadness, depression, enjoyment, worry and general happiness. For each of the 8 questions, responses were recorded on a four-point scale. For example, responses to questions like "*During the past seven days: You enjoyed life.*" were recorded as: never or rarely, sometimes, a lot of the time and most of the time or all of the time.

The bimodal scale (0-0-1-1) was chosen over the Likert scale (0-1-2-3) to arrive at the mental health score used in this study as it is found to be better at predicting depression (Goldberg, 1985) and severity of psychiatric illness (Goldberg and Huxley, 1980). A lower mental health score on a 0-8 scale therefore indicates good mental health of the respondent, while a higher score represents poor mental health or psychological distress.

For suicidal thoughts and visits to a counselor, we concentrate on the following two questions also available in the survey: "*During the past 12 months, have you ever seriously thought about committing suicide?*"[7] and "*In the past 12 months, have you received psychological or emotional counseling?*" with a response of either yes or no.

The descriptive statistics for self-reported sleeping patterns and different physical and psychological measures of health used in this paper are presented in Table 1. An average individual in the sample is found to sleep for about 7.5 hours on a normal working day (with

[6] Add Health collected information on 8 of the 12 items of the General Health Questionnaire (GHQ-12) in wave-III and wave-IV. We therefore make use of a shorter version (8-item version) of the GHQ-12 score to study mental health of the individuals in our sample.
[7] Interestingly, nearly 16.71% of the sample who contemplate suicide actually attempt it.

standard deviation of 1.23), usually sleeping between the hours of 23:00 and 01:00 and waking up between the hours of 06:00 and 08:00.[8,9] In general, respondents consider their physical health to be very good and their mean mental health score is also very low, indicating comparatively good overall health. Nearly 6.3% of the respondents have had suicidal thoughts and about 8.5% have received psychological or emotional counseling during the past year. Figure 1 illustrates the relationship between general health and hours of sleep (per day) on a normal working day. Figure 1 indicates that there exists a non-linear relationship between general health and hours of sleep, which is U-shaped — indicating an initial fall in the health score with increase in hours of sleep, followed by a rise thereafter, i.e. the health outcome improves at first and then starts deteriorating after a certain threshold level is reached.

[Place Table 1 here]

[Place Figure 1 here]

3. Methodology

The overall goal of this paper is to examine whether there exists an association between sleep duration (and pattern) and different measures of subjective wellbeing — such as general health, mental health, suicide thoughts and taking help of counseling services; after controlling for other variables that also affect physical and psychological wellbeing. For this purpose, we consider the following standard regression model:

$$h_{it} = \alpha_i + \beta_1 X_{it} + \gamma\, Sleep_{it} + \delta\, (Sleep_{it})^2 + \theta\, S_k + \lambda\, \tau_t + \varepsilon_{it} \qquad (1)$$

where, the dependent variable, h_{it}, captures the subjective wellbeing (both physical as well as mental) of individual i during wave t and ε_{it} is the individual specific error term which is non-systematic in nature and varies across individuals. We are particularly interested in the sign and value of the parameters – γ and δ[10], associated with the variables – $Sleep_{it}$ *and* $(Sleep_{it})^2$, which capture the hours[11] an individual i usually sleeps on a normal working day during wave t and its squared. These parameters are therefore mean slopes associated with the $Sleep_{it}$ *and* $(Sleep_{it})^2$ variables. Alternatively, we also focus on sleep pattern of the individual respondent

[8] Wake up time and sleep time have been reported in the 24-hour clock time format.

[9] According to the National Sleep Foundation, in 2008, Americans' on an average slept for 6 hours 40 minutes on workdays while their average workday wake up time was 05:35 and average workday bed time was 22:53, which is quite similar to the Add Health data on sleep duration and sleep habits. Retrieved from https://www.sleepfoundation.org/sites/default/files/inline-files/2008%20POLL%20SOF.PDF

[10] Figure 1 and Appendix Figure 1 shows a U-shaped relationship between hours of sleep and the outcome variables - self-assessed health and mental health.

[11] The exclusion criterion for hours of sleep is taken as less than or equal to 3 (<=3) or greater than 11 (>11) as less than 0.003% of the sample sleeps less than 3 hours or greater than 11 hours on a normal working day.

captured by separately including sleep and wake-up time in the same regression instead of hours of sleep and sleep squared.

Equation (1) therefore helps us to establish the link between hours of sleep and subjective wellbeing (such as general health, mental health, suicide thoughts and taking help of counseling services, taken individually), after controlling for the effect of different individual and household level characteristics that may also affect health and wellbeing of an individual. We include: age, adjusted age squared (age squared divided by 100), gender, household size, household size squared, body mass index (weight in kg by height in meters squared)[12], ethnicity (White, Black or African American, American Indian or Alaska Native, Asian or Pacific Islander), level of education (a dummy indicating whether an individual has completed at least a bachelor's degree), employment status (a dummy indicating whether an individual is currently working for pay for at least 10 hours a week), log of real household income (annual household income measured in thousand dollars in 2005 prices[13]) and a U.S. born dummy (a dummy indicating whether an individual was born in the U.S.). We also include seasonal fixed effects and wave fixed effects to account for the variation in health outcomes across seasons and waves. The descriptive statistics for all the control variables used in the analysis is presented in Table 2 in the Appendix.

At first, we run a series of ordinary least squares (OLS) regressions by including different indicators for health (individually one at a time) as the dependent variable and hours of sleep and sleep squared (and then alternatively sleep pattern) as the variables of interest, after controlling for the effect of other explanatory variables, with clustered standard errors at the individual level. However, as there are a number of unobserved confounding factors like personality and past habits, which may also affect individual health, we present a second set of estimates in addition to the OLS estimates, by exploiting the panel structure of the dataset and including individual level fixed effects in the analysis. In addition to this, in order to allow for the presence of non-linearity in the sleep-health relationship, we further divide hours of sleep into 3 sub-groups, namely, less than 6 hours of sleep (<6 hours), 6 – 8 hours of sleep (i.e. >=6 hours and <8 hours) and more than 8 hours of sleep (i.e. >=8 hours)[14] and include them in the baseline regressions in the place of hours of sleep and sleep squared.

[12] Height and weight were measured by the interviewer and not self-reported by the respondents.
[13] The Consumer Price Index for All Urban Consumers, which accounts for nearly 88% of the total population, has been used to calculate the real household income.
[14] Figure 1 and Appendix Figure 1 show a U-shaped curve, with its lowest point at around 8 hours of sleep.

Studies on sleep and health, so far, have mostly concentrated on hours of sleep and completely ignored the importance of sleep pattern. In order to find out whether sleep pattern — specifically waking up and sleep time (getting to bed) also matter, in successive regressions, we replace hours of sleep and its squared with sleep time and wake up time. To be specific, we separate out the sleep hours into specific sleep time and wake up time slots and re-run equation (1) with different sleep time groups such as: individuals who go to sleep between the hours of 20:00 – 23:00 (>=20:00 and <23:00), 23:00 – 01:00 (>=23:00 and <01:00) and 01:00 – 03:00 (>=01:00 and <03:00); and wake up time groups: individuals who wake up between the hours of 04:00 – 06:00 (>=04:00 and <06:00), 06:00 – 08:00 (>=06:00 and <08:00) and 08:00 – 10:00 (>=08:00 and <10:00).

We also conduct a falsification test in order to negate the possibility of spurious results and undertake a series of sensitivity analysis to establish the relationship between sleep (both duration and timing) and health outcomes by addressing the endogeneity problem and the issue of reverse-causality in this context as it is possible that people with poor physical or psychological health (to begin with) or those with certain unobserved characteristics may be more likely to self-select into unhealthy sleeping habits such as only limited sleep or sleeping late at night. We eliminate these concerns by taking recourse to the propensity score matching (PSM) technique and the instrumental variable approach.

For PSM, individuals with healthy sleeping habits (individuals who sleep for at least 6 hours, go to bed between 20:00 – 23:00 hours and wake up before 08:00 hours) are compared with individuals with unhealthy sleeping habits[15]. For the instrumental variable approach, we have used sleep duration and sleep pattern from the previous wave (that is, the lag of the sleep variables) as an instrument for current sleep duration and sleep pattern respectively as we believe that "lag of sleep habits" only has an effect on current health outcomes indirectly via

[15] During the matching exercise, in addition to the usual controls we also controlled for whether has a child aged below six years (a dummy which takes the value 1 if the household has children below six years of age and zero otherwise), work shift (a dummy which took the value 0 if the individual worked in a regular shift and 1 if the person had an evening or night shift), missed work due to health issues (with value 1 indicating yes, and 0 otherwise), whether has health and financial problems. Individuals who could do moderate activities (such as moving a table, pushing a vacuum cleaner, bowling and playing golf) and who did not have cancer or lymphoma or leukemia, high blood cholesterol or triglycerides or lipids, high blood pressure or hypertension, high blood sugar or diabetes, depression, epilepsy or another seizure disorder currently or in the past were considered to have no health issues. Individuals (the respondent or their household) who were without phone service, "*didn't pay the full amount of the rent or mortgage*", were evicted from their house or apartment for not paying the rent or mortgage, "*didn't pay the full amount of a gas, electricity, or oil bill"* or *"had the service turned off by the gas or electric company, or the oil company wouldn't deliver*" because they didn't have enough money were considered to have financial problems. Moreover, during matching we also controlled for overweight dummy (where 1 indicates BMI greater than 25, and zero otherwise), instead of BMI.

current sleep habits and has no direct effect on these health outcomes. As our dataset is derived from waves-III and IV of Add Health, the lag of sleep duration and sleep pattern is from wave-III and wave-II respectively. Here, in addition to the usual hours of sleep; for the non-linear effects, we consider a dummy variable which takes a value of 1 if an individual sleep for at least 6 hours and zero otherwise. Similarly, for sleep pattern, a dummy variable "early to bed and early to rise" is created, which takes the value 1 if an individual goes to bed between 20:00 and 23:00 and wakes up before 08:00 and takes the value 0 if an individual goes to bed after 23:00 and wakes up after 08:00.

4. Results

The regression results estimated using equation (1), illustrating the association between sleep hours and sleep pattern (wake up and sleep time) and various physical and mental health measures are presented in Tables 2 and 3. After controlling for the effect of individual and household level covariates, columns I, III and V report the OLS estimates for each health measure while columns II, IV and VI report the individual level fixed effect (FE) estimates. In each case, the fixed effect estimates with full set of controls is our preferred model as it controls for unobserved individual and household level fixed effects that may also affect the health outcomes and therefore bias the OLS estimates. Moreover, for each health measure, the first two columns report the regression estimates of hours of sleep and hours of sleep squared, the next two columns present the coefficients associated with the non-linear model for hours of sleep, while the last two columns report the results related to sleeping pattern, that separates out the wake up and sleep time but uses them both in the same regression.

[Place Table 2 here]

4.1 Baseline Regression Results

The regression estimates presented in Table 2 report the effect of hours of sleep on a normal working day (and also wake up and sleep time) on health (general and mental health)[16]. The OLS estimates presented in columns I and VII of Table 2 suggest that all the coefficients associated with hours of sleep and hours of sleep squared are significant. As hours of sleep increases, general (and mental) health scores decreases by 0.213SD (and 0.449SD), that is both physical as well as psychological health improve at first, but eventually more sleep results in

[16] Regression estimates for the baseline model with the full set of controls are available in Tables 3 and 4 in the Appendix.

an increase in general (and mental) health scores after a certain threshold level is reached – indicating deterioration in health outcomes, which strictly suggests a U-shaped relation between sleep and health. Based on our preferred model presented in columns II and VIII, the estimates from our general and mental health regressions suggest that an additional hour of sleep lowers general health score by 0.308SD (that is better physical health) but excessive sleep is associated with an increased score, thus excessive sleep could indeed be detrimental for physical health but the results related to mental health are not significant. Additionally, when we calculate the threshold level we find that about 7 hours of sleep is ideal for good physical health[17] while the optimal amount of sleep for good mental health is about 9 hours, which is higher than that required for good health in general, though not significant.

On observing the non-linear effects of sleep on health outcomes (as presented in columns III, IV, IX and X), the OLS results in columns III and IX show that both the coefficients associated with 6 to 8 hours of sleep and more than 8 hours of sleep (relative to less than 6 hours) are significant. General health, on an average, is around 0.143SD less when an individual sleep for 6 to 8 hours compared to when (s)he sleeps for less than 6 hours and is 0.190SD less if an individual sleep for more than 8 hours. To determine if there exists any statistical difference between the coefficients related to 6 to 8 hours of sleep and more than 8 hours of sleep, we report the Wald statistics. The Wald Statistics is insignificant and thus shows that we cannot reject the null hypothesis that the coefficients of the two variables (6 to 8 hours of sleep and more than 8 hours of sleep) are significantly different – indicating that significant difference between the coefficients of these variables in terms of general health (and mental health) do not exist. We find similar effects for mental health. Therefore, individuals who sleep for 6 to 8 hours and more than 8 hours of sleep have been found to have similar general health (and mental health) confirming that at least 6 hours of sleep is related to better physical and mental health. The fixed effect estimates in columns IV and X again confirm the OLS results that at least 6 hours of sleep is associated with good mental health but the results for physical health are not significant anymore when the preferred FE model is used.

Moreover, columns V, VI, XI and XII of Table 2 focuses on the sleeping pattern and present the results associated with the relationship between wake up and sleep time and general and mental health. The regression estimates of the OLS results suggest that, after netting out the

[17] The optimal hours of sleep for various subjective wellbeing measures are calculated using the first order conditions. The first order condition gives us the minima or the threshold level for hours of sleep = $-\gamma/2\delta$.

effect of all other controls, general health deteriorates by 0.095SD if individuals sleep between the hours of 23:00 and 01:00 than when (s)he sleeps early, i.e., between the hours of 20:00 and 23:00. Similarly, an individual's health becomes worse by 0.219SD if s(he) sleeps between the hours of 01:00 and 03:00 than between the hours of 20:00 and 23:00. Also, an individual's overall physical health becomes worse by 0.065SD if (s)he wakes up between the hours of 06:00 and 08:00 compared to between the hours of 04:00 and 06:00. Therefore, the OLS results indicate that the ideal sleep time for better general health is between the hours of 20:00 and 23:00 and the ideal wake up time is between the hours of 04:00 and 06:00. The FE results confirm that the ideal wake up time is indeed between the hours of 04:00 and 06:00 while there is no significant effect of sleep time.

Similarly, we find that respondents also have better mental health if they sleep between the hours of 20:00 and 23:00 while the wake-up time has no significant effect on mental health. On observing the individual level fixed effect results, we find that wake up time has an important role to play for physical health while sleep time matter only for mental health. Individuals, on an average, therefore have better general health if they wake up between the hours of 04:00 and 06:00 in comparison to individuals waking up after 06:00 in the morning while those who sleep before 01:00 have better mental health. No such significant effect is found for wake up time when mental health is considered[18].

[Place Table 3 here]

Table 3, on the other hand, reports the effect of sleep on probability of having suicidal thoughts and visiting a counselor. When we focus on the preferred FE results, we find that an additional hour of sleep reduces the probability of having suicidal thoughts at first but increases it thereafter.[19] Moreover, the regression coefficients for 6 to 8 hours of sleep and more than 8 hours of sleep are negative and significant, indicating significantly lower chances of having suicidal thoughts when an individual sleep for 6 to 8 hours and more than 8 hours than when (s)he sleeps for less than 6 hours. The Wald Statistics, however, report insignificant difference

[18] Level of education (a dummy indicating whether an individual has completed at least a bachelor's degree) is used as one of the controls in the regression Equation (1). However, nearly 12.29% of the sample were younger than 21 years of age and were unlikely to have been able to complete a bachelor's degree. As a robustness check, we re-run Equation (1) twice. In the first set of regressions, we re-define the control variable "level of education" as a dummy indicating whether an individual has completed at least their high-school. In the second set of regressions, we re-run the regression after excluding those individuals aged below 21 years from the analysis. Regression results for both are similar to Tables 2 and 3 and will be made available upon request.

[19] The threshold level of sleep hours is reached at around 8 hours 10 minutes. Thereafter, the probability of having suicidal thoughts increases.

between the coefficients associated with 6 to 8 hours of sleep and more than 8 hours of sleep. Similarly, the probability of visiting a counselor also decreases significantly for an individual who sleeps for more than 8 hours.

Sleep time also seems to matter and individuals who sleep late at night, i.e., between the hours of 01:00 and 03:00 (as compared to sleeping between the hours of 20:00 – 23:00) have a higher probability of having suicidal thoughts (7.2% more likely) and are 5.4% more likely to visit a counselor and therefore sleeping early, particularly before 01:00 is recommended. Wake up time, however, is found to matter only in the case of having suicidal thoughts. An individual who wakes up between the hours of 06:00 and 08:00 is 3.2% less likely to have suicidal thoughts than a person who gets up earlier but wake up time does not seem to matter for the probability of visiting a counselor.

The overall results presented in Tables 2 and 3, therefore suggest that both sleep duration and pattern matter for overall health – physical as well as mental health.[20] An average American, who sleeps for 7 hours have good general health, for more than 6 hours have good mental health and lower probability of suicidal thoughts and for more than 8 hours have reduced probability of visiting a counselor. Also, individuals who sleep really late, i.e., after 01:00 are more prone to depression, have increased probability of suicidal thoughts and are more likely to go to a counselor. Individuals who wake up early, on the other hand, (i.e., between the hours of 04:00 and 06:00) have better physical health, while individuals who wake up after 06:00 in the morning have lower chances of having suicidal thoughts. Therefore, in addition to a good night sleep, sleeping early as well as waking up early seem to be associated with improved physical and mental health.

In order to rule out the possibility of any spurious correlation between sleep hours and pattern and the various health outcome variables used in the analyses so far, we also conduct a falsification test. This is done by replacing the dependent variable with health outcomes such

[20] There were some individuals in the dataset who didn't respond to all the questions (of our variables of interest). These data points were excluded from the analysis. Number of observations is more in case of wave-IV as compared to wave-III. However, this is not because a smaller number of individuals were interviewed in wave-III (than in wave-IV). It is majorly due to missing observations. As a robustness check, we re-run Equation (1) with only those 1301 individuals who responded to all the variables of interest (and 1278 individuals who responded to the question on suicide thoughts) in both the waves. The results are made available in Tables 5 and 6 in the Appendix and are similar to Tables 2 and 3.

as hearing/eyesight problems[21] and doctor diagnosed cancer[22], which hours of sleep (and wake up and sleep time) should not predict. Table 4 presents the results from the falsification tests. As expected, all the coefficients associated with hours of sleep (and wake up and sleep time) as well as the Wald Statistics are insignificant, giving confidence that our results in Tables 2 and 3 are indeed not spurious.

[Place Table 4 here]

[Place Tables 5 & 6 here]

4.2 Sensitivity Analysis

Finally, we establish that there indeed exists a strong causal association between sleep (both duration and pattern) and health outcomes and that the direction of the effect is from better sleeping habits to improved physical and psychological health by running a series of sensitivity analysis and robustness checks. Towards this end, we first consider only a sub-sample of individuals, i.e. we exclude those who had health and financial problems to begin with. Individuals who could do moderate activities (such as moving a table, pushing a vacuum cleaner, bowling and playing golf) and who did not have cancer or lymphoma or leukemia, high blood cholesterol or triglycerides or lipids, high blood pressure or hypertension, high blood sugar or diabetes, depression, epilepsy or another seizure disorder currently or in the past were considered to have no health issues. Individuals who suffered from financial problems, such as individuals (the respondent or their household) who were without phone service, "*didn't pay the full amount of the rent or mortgage*", were evicted from their house or apartment for not paying the rent or mortgage, "*didn't pay the full amount of a gas, electricity, or oil bill"* or *"had the service turned off by the gas or electric company, or the oil company wouldn't deliver*" because they didn't have enough money were dropped from the analyses. The regression results presented in Tables 5 and 6 are very similar to that in Tables 2 and 3 and confirm that among individuals without any health or financial stress, those with healthy sleeping habits and patterns have comparatively better physical and mental health outcomes i.e. we eliminated the possibility that the sick and the stressed may have poor sleeping habits. We also find evidence

[21] An individual is considered to have a hearing problem if their response to the question "*How is your hearing? If you wear a hearing aid, describe your hearing without it.*" is either "*a little trouble*", "*moderate hearing trouble*", "*a lot of trouble*" or "*deaf*" in wave-IV and fair, poor, very poor or deaf in wave-III. An individual is considered to have an eyesight problem if they wear lenses/glasses.

[22] For doctor diagnosed cancer, the respondents were asked the following question: "*Have you ever been diagnosed with cancer or leukemia?*".

that sleep during the weekends cannot compensate for the ill-effects associated with poor sleeping habits during the weekdays and a good night sleep during the weekday really matters for improved physical and psychological health while that during the weekends is found not to have a significant effect; see Tables 7 and 8 in the Appendix.

As a robustness check, we also re-run Equation (1) with additional controls, namely, whether the individual missed work due to health problems (a dummy variable which takes the value 1 if in the past 30 days a respondent missed work due to health issues and 0 otherwise), has morning shift work (a dummy variable which takes the value 1 if the respondent was employed in a regular morning shift job (from 8am/9am to 5pm/6pm), 0 otherwise), has any child below the age of six (a binary variable which denotes whether the respondent had any child in the house below the age of 6 years) and performs physical activity (i.e. in the past 7 days, whether the respondent did any kind of physical activity, for example did (s)he bicycle, skateboard, dance, hike, hunt, roller blade, roller skate, downhill ski, snow board, play racquet sports or do aerobics; did strenuous team sports such as football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey, play golf, did fishing, bowling, or play softball or baseball, or did walk as a form of exercise). The results are again somewhat similar to the baseline results and are made available in Tables 9 and 10 in the Appendix. In addition, when we add the respective lagged outcome variables as additional controls to the baseline regressions in order to control for the possibility that past health may affect current sleeping patterns and therefore current health status, we find evidence that the results in Tables 11 and 12 in the Appendix are again similar to the baseline results suggesting that sleeping patterns indeed affect physical and psychological wellbeing of the individuals.

Next, we present the PSM results in Table 7 where we match individuals with healthy sleeping habits with unhealthy sleeping habits individuals based on a series of individual and household level characteristics. The PSM results are again somewhat similar to the baseline results presented in Tables 2-3.[23] For the instrumental variable approach, when we use lag of sleep duration and sleep pattern as instruments for sleep duration and sleep pattern respectively, the results presented in Table 13 in the Appendix suggest that hours of sleep have an effect on only general health. While observing the non-linear results, we find that atleast 6 hours of sleep is good for overall physical health. Furthermore, it is recommended to wake up and sleep early (i.e. an individual should go to bed between 20:00 and 23:00 and wake up before 08:00 in the

[23] The results for the PSM balance test will be made available upon request.

morning) to have improved mental health. The F-statistics indicate that the lag of the respective sleep pattern is a strong instrument for current sleep pattern.

5. Conclusion

There has been a paramount increase in the number of individuals suffering from mental health issues and this number is expected to rise further in the future (WHO, 2017a; 2017b; WHO, 2003; Mental Health in America – Adult Data, 2017). Alongside, governments have been directed to increase expenditures in service related to mental illnesses by nearly 20% by 2020 (WHO, 2013; 2015). Interestingly, both direct and indirect cost of mental illness is also expected to double by 2030 (Trautmann et al., 2016). The major reason we undertook this study was to investigate whether a small behavioral change such as changing the sleeping habit or pattern of an individual could end up saving millions of dollars in healthcare expenditure for governments and individuals. Moreover, studies, especially in the medical literature have concentrated on hours of sleep and completely neglected sleep pattern such as wake up and sleep time, which we consider to be equally important for subjective wellbeing.

In the current paper, we have examined in detail the relationship between sleeping habits (both sleep duration and wake up and sleep timing) and health (both physical and psychological health) among young U.S. adults using a wide range of estimation strategies. The fixed effect results along with the falsification test, PSM technique, instrumental variable approach and different sensitivity analyses give some weight to the fact that a direct causal relationship is indeed there and the direction of the effect as is evident is from better sleeping habits (and patterns) to improved physical and psychological health. The major take-away message from our findings is that both sleep duration and pattern (sleep time and wake up time) affects physical and psychological wellbeing of an individual. Overall, on a normal working day, an average American can be prescribed to sleep for at least 6 hours for good mental health, for reducing the probability of having suicidal thoughts and visiting a counselor due to mental health issues. As sleeping late is found to deteriorate mental health and increase chances of psychological disorder, while waking up late affects physical health, campaigns to adopt a healthy sleeping pattern can be recommended.

As the saying goes "*Early to bed and early to rise, makes a person healthy, wealthy and wise*", we also find that the time of sleeping (going to bed) and waking up really matters for improved physical and psychological health. Therefore, we argue that given the mental health epidemic, recommending that people have healthy sleeping habits is an easy and straightforward policy

option. Additionally, as this is a costless move, the benefits are likely to outweigh the costs. So, a simple policy message such as "*Sleep healthy*" by the government could be an effective step towards curbing the upward trend in mental health issues, suicide rates and will be beneficial for the overall physical and mental health of the society.

However, the study has a few limitations. There could be a possibility of measurement error. For instance, sleep deprivation could affect reporting behavior. Moreover, the outcome variable - access to counseling service - may not necessarily depict a worse state of wellbeing, specifically due to those individuals who lack the confidence to report and/or seek help for mental health issues. Broken/irregular sleep is again something we could not include in the analyses. Furthermore, due to the lack of access to detailed location identifiers in the Add Health data (for confidentiality reasons) we could not merge our dataset with available sunrise and sunset data, which could have then been used as an instrument for wake up and sleep time.

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References:

Antillón, M., Lauderdale, D. S., & Mullahy, J. (2014). Sleep behavior and unemployment conditions. *Economics & Human Biology*, *14*, 22-32.

Ásgeirsdóttir, T. L., & Ólafsson, S. P. (2015). An empirical analysis of the demand for sleep: Evidence from the american time use survey. *Economics & Human Biology*, *19*, 265-274.

Biddle, J.R. & Hamermesh, D.S. (1990). Sleep and the Allocation of Time. *Journal of Political Economy*, *98*(5, Part 1), 922-943.

Blanchflower, D.G., Oswald, A.J. & Stewart-Brown, S. (2013). Is psychological wellbeing linked to the consumption of fruit and vegetables? *Social Indicators Research*, *114*(3), 785-801.

Capacci, S. & Mazzocchi, M. (2011). Five-a-day, a price to pay: an evaluation of the UK program impact accounting for market forces. *Journal of health economics*, *30*(1), 87-98.

Gibson, M. & Shrader, J. (2018). Time use and productivity: The wage returns to sleep. *Review of Economics and Statistics*, forthcoming.

Goldberg, D. (1985). Identifying psychiatric illness among general medical patients. *British medical journal (Clinical research ed.)*, *291*(6489), 161.

Goldberg, D., & Huxley, P. (1980). Mental Illness in the Community: The Pathway to Psychiatric Care. London: Tavistock Publications.

Jacka, F.N., Kremer, P.J., Berk, M., de Silva-Sanigorski, A.M., Moodie, M., Leslie, E.R., Pasco, J.A. & Swinburn, B.A. (2011). A prospective study of diet quality and mental health in adolescents. *PloS one*, *6*(9), e24805.

Kamstra, M.J., Kramer, L.A. & Levi, M.D. (2000). Losing sleep at the market: The daylight saving anomaly. *American Economic Review*, *90*(4), 1005-1011.

Lalji, C., Pakrashi, D. & Smyth, R., (2018). Can eating five fruit and veg a day really keep the doctor away?. *Economic Modelling 70*,320-330.

Lordan, G. & Pakrashi, D. (2014). Make time for physical activity or you may spend more time sick!. *Social indicators research*, *119*(3), 1379-1391.

Lordan, G. & Pakrashi, D. (2015). Do all activities "weigh" equally? How different physical activities differ as predictors of weight. *Risk Analysis*, *35*(11), .2069-2086.

Mental Health in America – Adult Data. (2017).
http://www.mentalhealthamerica.net/issues/mental-health-america-adult-data

Mujcic, R. (2014). Are fruit and vegetables good for our mental and physical health? Panel data evidence from Australia. MRPA Paper No. 59149.

Mujcic, R. & J. Oswald, A. (2016). Evolution of wellbeing and happiness after increases in consumption of fruit and vegetables. *American journal of public health*, *106*(8), 1504-1510.

Sedigh, G., Devlin, R. A., Grenier, G., & Armstrong, C. D. (2017). Revisiting the relationship between wages and sleep duration: The role of insomnia. *Economics & Human Biology*, *24*, 125-139.

Smith, A.C. (2016). Spring forward at your own risk: daylight saving time and fatal vehicle crashes. *American Economic Journal: Applied Economics*, *8*(2), 65-91.

Szalontai, G. (2006). The demand for sleep: A South African study. *Economic Modelling*, *23*(5), 854-874.

Trautmann, S., Rehm, J. & Wittchen, H.U. (2016). The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders?. *EMBO reports*, e201642951.

Wannamethee, S.G., Shaper, A.G. & Walker, M. (1998). Changes in physical activity, mortality, and incidence of coronary heart disease in older men. *The Lancet*, *351*(9116), 1603-1608.

Warner, R.M., Frye, K., Morrell, J.S. & Carey, G. (2017). Fruit and Vegetable Intake Predicts Positive Affect. *Journal of Happiness Studies*, *18*(3), 809-826.

Watson, N.F., Badr, M.S., Belenky, G., Bliwise, D.L., Buxton, O.M., Buysse, D., Dinges, D.F., Gangwisch, J., Grandner, M.A. & Kushida, C. (2015). Joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society on the recommended amount of sleep for a healthy adult: methodology and discussion. *Sleep*, *38*(8), 1161-1183.

World Economic Forum. (2011). The global economic burden of non-communicable diseases. World Economic Forum, the Harvard School of Public Health, Geneva.

World Health Organization. (2003). Investing in Mental Health

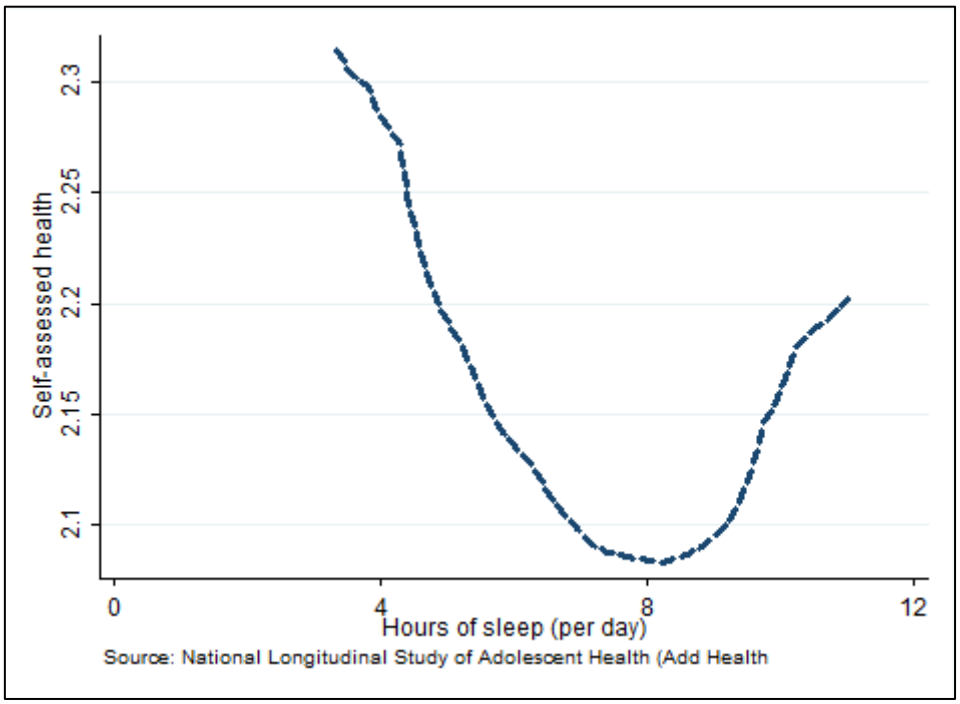
World Health Organisation. (2013). Mental health action plan 2013 - 2020

World Health Organisation. (2015). Health in 2015: From MDGs to SDGs http://apps.who.int/iris/bitstream/10665/200009/1/9789241565110_eng.pdf?ua=1

World Health Organization. (2017a). Depression and Other Common Mental Disorders: Global Health Estimates. Geneva.

World Health Organisation. (2017b). Mental disorders: Factsheet. http://www.who.int/mediacentre/factsheets/fs396/en/

Figure 1: Non-linear relationship between self-assessed health and sleep duration



Note: Hours of sleep on a normal working day is plotted on the x-axis, while the self-assessed health score is on the y-axis. The self-assessed health scores are responses to the question: "*In general, how is your health?*" with response options: excellent, very good, good, fair and poor. The responses are recorded on a scale of 1 to 5, with 1 being excellent health and 5 poor health.

Table 1: Descriptive Statistics

Variables of interest	No. of observations	Mean	Std. Dev.	Min	Max
Outcome variables					
General health	4379	2.138	0.883	1.00	5.00
Mental health	4379	0.770	1.374	0.00	8.00
Suicide thoughts	4339	0.063	0.242	0.00	1.00
Counseling	4377	0.085	0.278	0.00	1.00
Sleep duration & pattern					
Hours of sleep	4379	7.482	1.227	3.50	11.00
Hours of sleep squared	4379	57.48	18.28	12.25	121.00
Sleep hours (Ref: less than 6 hours of sleep)					
6 – 8 hours	4379	0.501	0.500	0.00	1.00
More than 8 hours	4379	0.419	0.493	0.00	1.00
Sleep time (Ref: 20:00 – 23:00)					
23:00 – 01:00	4379	0.498	0.500	0.00	1.00
01:00 – 03:00	4379	0.128	0.334	0.00	1.00
Wake up time (Ref: 04:00 – 06:00)					
06:00 – 08:00	4379	0.584	0.493	0.00	1.00
08:00 – 10:00	4379	0.185	0.388	0.00	1.00

Note: General health scores are responses to the question: "*In general, how is your health?*" with response options: excellent, very good, good, fair and poor. The responses are recorded on a scale of 1 to 5, with 1 being excellent health and 5 poor health. The mental health score is calculated with the bimodal scale (0-0-1-1) using questions on ability to concentrate and overcome unhappiness; on perception of others opinion of the respondent and on sadness, depression, enjoyment, worry and general happiness. This score ranges from 0 to 8, with 0 indicating good mental health and 8 poor mental health. The variables Suicide thoughts and Counseling capture responses to the following questions: "*During the past 12 months, have you ever seriously thought about committing suicide?*" and "*In the past 12 months, have you received psychological or emotional counseling?*" respectively, which takes a value of 1 if yes, and zero otherwise.

Table 2: Regression results for general and mental health

Regression estimates	z-score of General Health						z-score of Mental Health					
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.227****	**-0.332***					**-0.478*****	-0.351				
	(0.104)	**(0.182)**					**(0.120)**	(0.232)				
Hours of sleep squared	**0.014***	**0.024****					**0.029*****	0.020				
	(0.007)	**(0.012)**					**(0.008)**	(0.015)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.143****	-0.084					**-0.224*****	**-0.285****		
			(0.057)	(0.094)					**(0.066)**	**(0.120)**		
More than 8 hours			**-0.190*****	-0.031					**-0.271*****	**-0.308****		
			(0.058)	(0.099)					**(0.068)**	**(0.130)**		
Wald Statistics			2.35	1.25					2.22	0.20		
p-Value			0.126	0.264					0.136	0.657		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.095*****	-0.058					**0.129*****	0.017
					(0.033)	(0.053)					**(0.034)**	(0.057)
01:00 – 03:00					**0.219*****	0.036					**0.265*****	**0.214***
					(0.054)	(0.091)					**(0.061)**	**(0.115)**
Wald Statistics					**0.678*****	1.49					**5.92****	**3.40***
p-Value					**0.009**	0.223					**0.015**	**0.065**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.065***	**0.131****					-0.057	-0.016
					(0.037)	**(0.060)**					(0.039)	(0.061)
08:00 – 10:00					0.064	**0.148***					-0.071	-0.108
					(0.052)	**(0.086)**					(0.057)	(0.099)
Wald Statistics					0.00	0.07					0.09	1.24
p-Value					0.992	0.785					0.763	0.365
Observations	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379
R-squared	0.123	0.154	0.124	0.151	0.128	0.155	0.049	0.027	0.046	0.028	0.048	0.025

Note: Hours of sleep, sleep time and wake up time relate to the sleep duration and pattern of an individual on a normal working day. The exclusion criterion for hours of sleep is taken as less than or equal to 3 (<=3) or greater than 11 hours (>11) as less than 0.003% of the sample sleeps less than 3 hours or greater than 11 hours on a normal working day. We present the OLS results in columns I, III, V, VII, IX and XI and in columns II, IV, VI, VIII, X and XII, the fixed effect model results. The following controls have been used: age, adjusted age squared (age squared divided by 100), gender, household size, household size squared, body mass index, ethnicity (White, Black or African American, American Indian or Alaska Native, Asian or Pacific Islander), level of education (a dummy indicating whether an individual has completed bachelor's degree), employment status (a dummy indicating whether an individual is currently working for pay at least 10 hours a week), log real income (annual household income measured in

thousand dollars in 2005 prices), US born (a dummy indicating whether an individual was born in US), seasonal and wave fixed effects. Data has been taken from two waves, namely wave III (2001-02) and wave IV (2008-09). Individuals of age group 18 to 34 have been included in the analysis. We report the regression coefficients for the hours of sleep, hours of sleep squared, various ranges of hours of sleep, wake up time and sleep time (per day) variables only. *, ** and *** denote significance at .10, .05 and .01 levels, with clustered standard errors at individual level in parentheses. The three Wald Statistic tests for the difference in the coefficients between the 6 – 8 hours and more than 8 hours of sleep; between 2300 – 0100 hours and 0100 – 0300 hours for sleep time; and between 0600 – 0800 hours and 0800 – 1000 hours for wake-up time. ***, **, and * on the Wald Statistic indicate that the null hypothesis that these coefficients are not significantly different can be rejected at the 1%, 5%, and 10% level of significance respectively.

Table 3: Regression results for symptoms of mental health problem

Regression estimates	Suicide Thoughts						Counseling					
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.108*** **	**-0.115***					-0.021	-0.073				
	(0.030)	**(0.059)**					(0.029)	(0.052)				
Hours of sleep squared	**0.006*** **	**0.007***					0.001	0.005				
	(0.002)	**(0.004)**					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.062*** **	**-0.067***					-0.011	-0.028		
			(0.018)	**(0.035)**					(0.016)	(0.029)		
More than 8 hours			**-0.069*** **	**-0.072** **					-0.016	**-0.052***		
			(0.019)	**(0.037)**					(0.016)	**(0.032)**		
Wald Statistics			0.85	0.15					0.21	2.43		
p-Value			0.356	0.700					0.645	0.120		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.020** **	-0.004					**0.024** **	0.012
					(0.008)	(0.015)					**(0.009)**	(0.017)
01:00 – 03:00					**0.072*** **	**0.072** **					**0.056*** **	**0.054***
					(0.016)	**(0.030)**					**(0.017)**	**(0.029)**
Wald Statistics					**12.03*** **	**8.81** **					**4.24** **	**2.72***
p-Value					**0.001**	**0.003**					**0.040**	**0.099**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.020** **	**-0.032***					0.000	-0.001
					(0.009)	**(0.018)**					(0.010)	(0.018)
08:00 – 10:00					-0.012	-0.022					0.010	-0.009
					(0.014)	(0.025)					(0.016)	(0.029)
Wald Statistics					0.50	0.26					0.56	0.11
p-Value					0.481	0.607					0.456	0.745
Observations	4,339	4,339	4,339	4,339	4,339	4,339	4,377	4,377	4,377	4,377	4,377	4,377
R-squared	0.016	0.037	0.013	0.036	0.017	0.044	0.023	0.027	0.023	0.029	0.027	0.028

Note: See notes to Table 2.

Table 4: Falsification Test

Regression estimates	Hearing and eyesight problem			Cancer		
Hours of sleep	-0.027			0.007		
	(0.067)			(0.019)		
Hours of sleep squared	0.003			-0.001		
	(0.004)			(0.001)		
Hours of sleep (Ref: less than 6 hours)						
6 – 8 hours		-0.015			-0.007	
		(0.038)			(0.014)	
More than 8 hours		0.011			-0.007	
		(0.039)			(0.015)	
Wald Statistics		1.54			0.00	
p-Value		0.214			0.998	
Sleep time (Ref: 20:00 – 23:00)						
23:00 – 01:00			-0.009			-0.003
			(0.022)			(0.006)
01:00 – 03:00			0.016			0.002
			(0.036)			(0.009)
Wald Statistics			0.62			0.64
p-Value			0.430			0.425
Wake up time (Ref: 04:00 – 06:00)						
06:00 – 08:00			0.037			0.001
			(0.024)			(0.008)
08:00 – 10:00			0.052			-0.002
			(0.032)			(0.012)
Wald Statistics			0.32			0.10
p-Value			0.569			0.747
Observations	4,244	4,244	4,244	4,378	4,378	4,378
R-squared	0.020	0.019	0.021	0.010	0.009	0.009

Note: These are the fixed effect results only. An individual is considered to have a hearing problem if their response to the question "*How is your hearing? If you wear a hearing aid, describe your hearing without it.*" is either "*a little trouble*", "*moderate hearing trouble*", "*a lot of trouble*" or "*deaf*" in wave-IV and fair, poor, very poor or deaf in wave-III. An individual is considered to have an eyesight problem if they wear lenses/glasses. An individual is considered to have had cancer if their response to the question "*Have you ever been diagnosed with cancer or leukemia?*" is yes. We took hearing/eyesight problem and cancer as the outcome variables in the falsification test as we expect no relationship between sleep duration; sleep pattern and hearing/eyesight problem and cancer. See notes to Table 2.

Table 5: Regression results for general and mental health using sub-sample

	z-score of General Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	-0.115	**-0.601****					**-0.350****	-0.395				
	(0.147)	**(0.278)**					**(0.137)**	(0.320)				
Hours of sleep squared	0.006	**0.040****					**0.021****	0.022				
	(0.010)	**(0.019)**					**(0.009)**	(0.020)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			-0.060	-0.104					**-0.148****	-0.228		
			(0.079)	(0.141)					**(0.073)**	(0.162)		
More than 8 hours			-0.124	-0.099					**-0.204*****	**-0.327***		
			(0.081)	(0.147)					**(0.074)**	**(0.169)**		
Wald Statistics			**2.95***	0.01					**3.15***	**2.91***		
p-Value			**0.086**	0.936					**0.076**	**0.088**		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.108*****	0.033					**0.141*****	**0.171*****
					(0.041)	(0.074)					**(0.035)**	**(0.056)**
01:00 – 03:00					**0.213*****	0.192					**0.178*****	**0.286****
					(0.071)	(0.142)					**(0.061)**	**(0.131)**
Wald Statistics					2.68	1.65					0.44	0.86
p-Value					0.102	0.199					0.509	0.354
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.099****	**0.161***					-0.056	-0.008
					(0.046)	**(0.088)**					(0.042)	(0.071)
08:00 – 10:00					0.096	0.135					**-0.097***	-0.101
					(0.066)	(0.127)					**(0.058)**	(0.109)
Wald Statistics					0.00	0.07					0.82	0.96
p-Value					0.946	0.790					0.365	0.326
Observations	2,481	2,481	2,481	2,481	2,481	2,481	2,481	2,481	2,481	2,481	2,481	2,481
R-squared	0.121	0.194	0.122	0.185	0.129	0.195	0.032	0.056	0.031	0.055	0.034	0.058

Note: As a sub-sample analysis, we have excluded individuals who had health and financial problems (to begin with) from the analysis. Individuals who could do moderate activities (such as moving a table, pushing a vacuum cleaner, bowling and playing golf) and who did not have cancer or lymphoma or leukemia, high blood cholesterol or triglycerides or lipids, high blood pressure or hypertension, high blood sugar or diabetes, depression, epilepsy or another seizure disorder currently or in the past were considered to have no health issues. We also excluded individuals who suffered from financial problems, such as individuals (the respondent or their household) who were without phone service, "*didn't pay the full amount of the rent or mortgage*", were evicted from their house or apartment for not paying the rent or mortgage, "*didn't pay the full amount of a gas, electricity, or oil bill"* or *"had the service turned off by the gas or electric company, or the oil company wouldn't deliver*" because they didn't have enough money. See notes to Table 2.

Table 6: Regression results for symptoms of mental health problem using sub-sample

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.088****	**-0.158****					0.006	-0.054				
	(0.038)	**(0.069)**					(0.029)	(0.064)				
Hours of sleep squared	**0.006****	**0.010****					-0.001	0.003				
	(0.002)	**(0.004)**					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.047****	**-0.075***					-0.012	**-0.046***		
			(0.022)	**(0.044)**					(0.017)	**(0.027)**		
More than 8 hours			**-0.046****	-0.071					-0.022	**-0.062***		
			(0.023)	(0.045)					(0.018)	**(0.032)**		
Wald Statistics			0.00	0.07					0.16	0.86		
p-Value			0.959	0.794					0.282	0.353		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.015***	0.030					**0.020****	**0.032***
					(0.009)	(0.019)					**(0.009)**	**(0.018)**
01:00 – 03:00					**0.028***	**0.081****					**0.059*****	**0.086****
					(0.017)	**(0.037)**					**(0.018)**	**(0.033)**
Wald Statistics					0.68	2.56					**5.69****	**3.59***
p-Value					0.411	0.110					**0.017**	**0.058**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.011	-0.028					0.010	-0.007
					(0.010)	(0.022)					(0.010)	(0.018)
08:00 – 10:00					-0.006	-0.026					-0.020	**-0.069****
					(0.015)	(0.029)					(0.013)	**(0.033)**
Wald Statistics					0.16	0.01					**6.86****	**3.90****
p-Value					0.689	0.913					**0.009**	**0.049**
Observations	2,460	2,460	2,460	2,460	2,460	2,460	2,480	2,480	2,480	2,480	2,480	2,480
R-squared	0.015	0.059	0.014	0.055	0.013	0.059	0.022	0.041	0.022	0.042	0.028	0.054

Note: See notes to Table 5.

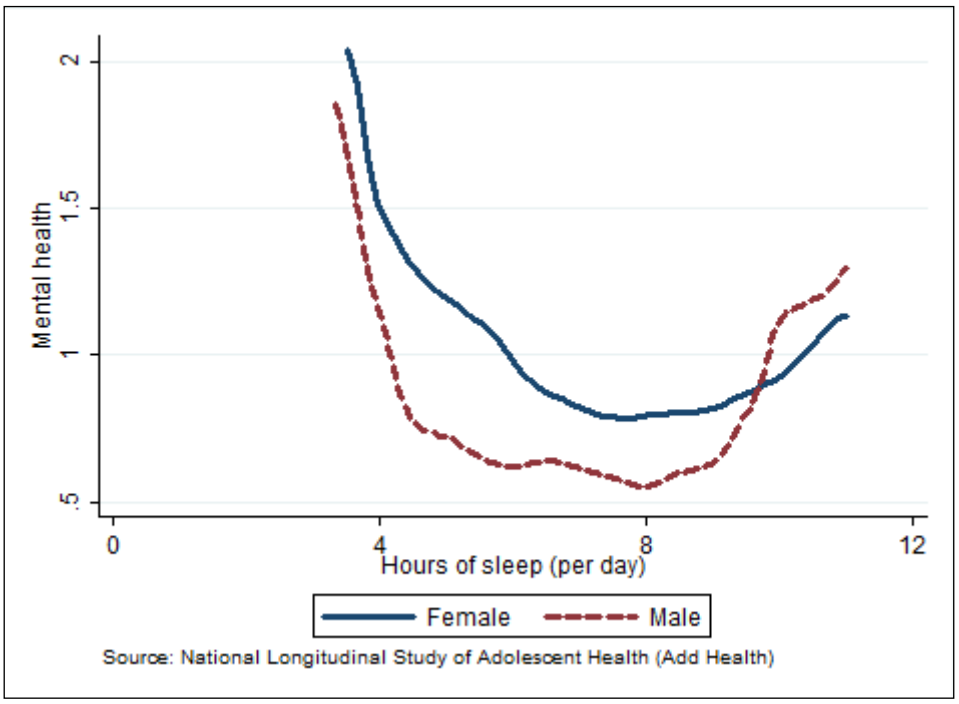
Table 7: Regression estimates using propensity score matching

Regression estimates	z-score of General Health			z-score of Mental Health			Suicide Thoughts			Counseling		
Hours of sleep	**-0.218***			**-0.443*****			**-0.102*****			0.000		
	(0.116)			**(0.131)**			**(0.033)**			(0.032)		
Hours of sleep squared	0.013			**0.027*****			**0.006*****			-0.000		
	(0.008)			**(0.009)**			**(0.002)**			(0.002)		
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours		**-0.147****			**-0.203*****			**-0.065*****			-0.016	
		(0.060)			**(0.068)**			**(0.020)**			(0.017)	
More than 8 hours		**-0.192*****			**-0.259*****			**-0.078*****			-0.023	
		(0.062)			**(0.069)**			**(0.020)**			(0.018)	
Wald Statistics		1.91			**2.88**			2.50			0.55	
p-Value		0.167			**0.090**			0.114			0.459	
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00			**0.081****			**0.137*****			**0.021****			**0.023****
			(0.035)			**(0.035)**			**(0.009)**			**(0.010)**
01:00 – 03:00			**0.269*****			**0.256*****			**0.081*****			**0.067*****
			(0.058)			**(0.065)**			**(0.018)**			**(0.018)**
Wald Statistics			**12.72**			**4.03**			**13.37**			**6.63**
p-Value			**0.0004**			**0.045**			**0.0003**			**0.010**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00			0.049			**-0.072***			**-0.021****			-0.002
			(0.039)			**(0.040)**			**(0.010)**			(0.011)
08:00 – 10:00			0.039			-0.083			**-0.028***			-0.000
			(0.056)			(0.060)			**(0.015)**			(0.017)
Wald Statistics			0.05			0.05			0.27			0.02
p-Value			0.825			0.828			0.606			0.887
Observations	3,779	3,779	3,779	3,779	3,779	3,779	3,749	3,749	3,749	3,777	3,777	3,777
R-squared	0.130	0.131	0.136	0.054	0.052	0.054	0.018	0.017	0.019	0.029	0.029	0.034

Notes: For PSM, individuals with healthy sleeping habits (individuals who sleep for at least 6 hours, go to bed between 20:00 – 23:00 hours and wake up before 08:00 hours) were compared with individuals with unhealthy sleeping habits. During matching, in addition to the usual controls we also controlled for whether has a child aged below six years (a dummy which takes the value 1 if the household has children below six years of age and zero otherwise), work shift (a dummy which took the value 0 if the individual worked in a regular shift and 1 if the person had an evening or night shift), missed work due to health issues (with value 1 indicating yes, and 0 otherwise), health issues and financial problems. We also controlled for an overweight dummy (which takes a value of 1 if BMI is greater than 25, and zero otherwise), instead of BMI. See notes to Table 2.

ONLINE APPENDIX (NOT FOR PUBLICATION)

Appendix Figure 1: Non-linear relationship between mental health and sleep duration by gender



Note: Hours of sleep on a normal working day is plotted on the x-axis, while the mental health score is on the y-axis. The mental health score is calculated with the bimodal scale (0-0-1-1) using questions on ability to concentrate and overcome unhappiness; on perception of others opinion of the respondent and on feelings of sadness, depression, enjoyment, worry and general happiness. This score ranges from 0 to 8, with 0 indicating good mental health and 8 poor mental health.

Appendix Table 1: Statistics of Participating High Schools

Region		**Grade Span**	
Northeast	17	K-12	7
South	27	7-12	10
Midwest	19	9-12	49
West	17	10-12	7
		Other	7
School Type		**Metropolitan Status**	
Public	71	Urban	24
Catholic	3	Suburban	42
Other Private	6	Rural	14

Note: The current table on participating schools has been taken from Add Health Research Design Wave I-V, Carolina Population Center.

Appendix Table 2: Summary Statistics of the Control Variables

Control Variables	No. of Obs.	Mean	Std. Dev.	Min	Max
Age (in years)	4379	25.61	3.97	18.00	34.00
Adjusted age squared (age square divided by 100)	4379	6.71	2.03	3.24	11.56
Gender dummy (Ref: Female)	4379	0.43	0.50	0.00	1.00
Household size	4379	2.45	1.41	1.00	15.00
Household size squared	4379	8.00	10.25	1.00	225.00
Body Mass Index (BMI)	4379	26.67	5.31	14.78	39.99
Ethnicity (Ref: White)					
Black or African American	4379	0.20	0.40	0.00	1.00
American Indian or Alaska Native	4379	0.01	0.09	0.00	1.00
Asian or Pacific Islander	4379	0.03	0.18	0.00	1.00
US born dummy (Ref: No)	4379	0.96	0.21	0.00	1.00
Level of education (Ref: below bachelor's level)	4379	0.26	0.44	0.00	1.00
Log of real annual income	4379	3.13	1.16	0.82	5.17
Employment status (Ref: Currently not working)	4379	0.77	0.42	0.00	1.00
Season (Ref: Winter)					
Spring	4379	0.31	0.46	0.00	1.00
Summer	4379	0.21	0.41	0.00	1.00
Autumn	4379	0.27	0.44	0.00	1.00
Wave (Ref: Wave III)	4379	0.52	0.50	0.00	1.00

Note: The Gender dummy takes a value of 1 if male and 0 if female. Body mass index is weight (in kilograms) by height (in meters) squared. US born dummy takes a value of 1 if the respondent is born in the U.S. and zero otherwise. Level of education is another dummy variable which takes the value 1 if the respondent has completed bachelor's degree, and zero otherwise. Employment status on the other hand takes a value of 1 if the respondent is currently working, and zero otherwise. Log real income is the annual household income measured in thousand dollars in 2005 prices.

Appendix Table 3: Regression estimates for general and mental health with full set of controls

	z-score of General Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.227****	**-0.332***					**-0.478*****	-0.351				
	(0.104)	**(0.182)**					**(0.120)**	(0.232)				
Hours of sleep squared	**0.014***	**0.024****					**0.029*****	0.020				
	(0.007)	**(0.012)**					**(0.008)**	(0.015)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.143****	-0.084					**-0.224*****	**-0.285****		
			(0.057)	(0.094)					**(0.066)**	**(0.120)**		
More than 8 hours			**-0.190*****	-0.031					**-0.271*****	**-0.308****		
			(0.058)	(0.099)					**(0.068)**	**(0.130)**		
Wald Statistics			2.35	1.25					2.22	0.20		
p-Value			0.126	0.264					0.136	0.657		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.095*****	-0.058					**0.129*****	0.017
					(0.033)	(0.053)					**(0.034)**	(0.057)
01:00 – 03:00					**0.219*****	0.036					**0.265*****	**0.214***
					(0.054)	(0.091)					**(0.061)**	**(0.115)**
Wald Statistics					**6.78*****	1.49					**5.92****	**3.40***
p-Value					**0.009**	0.223					**0.015**	**0.065**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.065***	**0.131****					-0.057	-0.016
					(0.037)	**(0.060)**					(0.039)	(0.061)
08:00 – 10:00					0.064	**0.148***					-0.071	-0.108
					(0.052)	**(0.086)**					(0.057)	(0.099)
Wald Statistics					0.00	0.07					0.09	1.24
p-Value					0.992	0.785					0.763	0.265
Age	0.047	-0.149	0.049	-0.148	0.059	-0.138	0.102*	-0.012	0.106*	-0.010	0.111*	-0.001
	(0.054)	(0.091)	(0.054)	(0.091)	(0.054)	(0.091)	(0.057)	(0.099)	(0.057)	(0.099)	(0.057)	(0.099)
Adjusted age squared	-0.062	0.137	-0.069	0.134	-0.078	0.130	-0.206*	0.003	-0.214**	-0.004	-0.218**	-0.005
	(0.103)	(0.128)	(0.103)	(0.128)	(0.103)	(0.128)	(0.107)	(0.135)	(0.107)	(0.135)	(0.107)	(0.135)
Gender (Ref: Female)	-0.162***		-0.163***		-0.169***		-0.166***		-0.165***		-0.175***	
	(0.032)		(0.032)		(0.032)		(0.032)		(0.032)		(0.032)	
Household size	-0.046	0.038	-0.045	0.039	-0.043	0.037	-0.074**	-0.071	-0.072**	-0.070	-0.070**	-0.067
	(0.030)	(0.036)	(0.030)	(0.036)	(0.030)	(0.035)	(0.030)	(0.049)	(0.030)	(0.049)	(0.029)	(0.049)

Household size squared	0.009**	-0.000	0.009**	-0.000	0.009**	-0.000	0.014***	0.016**	0.013***	0.015**	0.014***	0.015**
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)	(0.008)	(0.004)	(0.007)
Body Mass Index	0.032***	0.042***	0.032***	0.043***	0.032***	0.043***	0.000	-0.014	0.000	-0.014	0.001	-0.014
	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)	(0.011)	(0.003)	(0.011)	(0.003)	(0.011)
Ethnicity (Ref: White)												
Black	0.023	-0.290	0.023	-0.319	0.023	-0.290	0.063	-0.308	0.068*	-0.302	0.069*	-0.310
or African American	(0.042)	(0.434)	(0.042)	(0.425)	(0.042)	(0.429)	(0.041)	(0.354)	(0.041)	(0.356)	(0.041)	(0.368)
American Indian	0.257	-0.035	0.257	-0.044	0.258	-0.005	0.206	0.464	0.206	0.480	0.202	0.482
or Alaska Native	(0.160)	(0.344)	(0.160)	(0.342)	(0.160)	(0.352)	(0.205)	(0.357)	(0.204)	(0.355)	(0.203)	(0.361)
Asian	0.302***	0.154	0.306***	0.150	0.295***	0.159	0.042	-0.579**	0.054	-0.595**	0.044	-0.582**
or Pacific Islander	(0.078)	(0.280)	(0.078)	(0.276)	(0.077)	(0.280)	(0.080)	(0.288)	(0.081)	(0.290)	(0.081)	(0.279)
US born (Ref: No)	-0.026	0.021	-0.022	0.028	-0.015	0.028	-0.078	-0.289	-0.071	-0.299	-0.066	-0.277
	(0.088)	(0.236)	(0.088)	(0.235)	(0.088)	(0.240)	(0.080)	(0.216)	(0.080)	(0.212)	(0.080)	(0.219)
Level of education	-0.386***	-0.161**	-0.388***	-0.158**	-0.402***	-0.150**	-0.206***	0.040	-0.211***	0.040	-0.219***	0.044
(Ref: Below	(0.036)	(0.074)	(0.036)	(0.074)	(0.037)	(0.075)	(0.035)	(0.093)	(0.035)	(0.093)	(0.035)	(0.092)
Bachelor's degree)												
Log of real annual income	-0.061***	-0.078***	-0.062***	-0.078***	-0.057***	-0.075***	-0.083***	-0.028	-0.085***	-0.030	-0.081***	-0.028
	(0.018)	(0.027)	(0.018)	(0.027)	(0.018)	(0.027)	(0.019)	(0.028)	(0.019)	(0.028)	(0.019)	(0.028)
Employment status	0.012	0.144**	0.006	0.136**	0.029	0.145**	-0.158***	-0.045	-0.167***	-0.044	-0.156***	-0.045
(Ref: Currently not employed)	(0.038)	(0.062)	(0.038)	(0.062)	(0.038)	(0.063)	(0.040)	(0.068)	(0.041)	(0.068)	(0.040)	(0.070)
Season (Ref: Winter)												
Spring	0.001	0.045	0.001	0.050	0.004	0.053	0.041	0.032	0.043	0.041	0.047	0.039
	(0.041)	(0.063)	(0.041)	(0.063)	(0.041)	(0.063)	(0.040)	(0.067)	(0.040)	(0.067)	(0.040)	(0.067)
Summer	-0.021	0.007	-0.023	0.005	-0.024	0.007	0.032	0.109	0.030	0.112	0.027	0.109
	(0.045)	(0.062)	(0.044)	(0.063)	(0.044)	(0.063)	(0.044)	(0.075)	(0.044)	(0.074)	(0.044)	(0.075)
Autumn	0.032	0.024	0.032	0.020	0.035	0.021	0.124***	0.114	0.127***	0.120*	0.128***	0.112
	(0.042)	(0.062)	(0.042)	(0.063)	(0.042)	(0.063)	(0.043)	(0.071)	(0.043)	(0.071)	(0.043)	(0.071)
Wave (Ref: Wave III)	0.424***	0.994**	0.427***	0.988**	0.407***	0.937**	0.260***	0.206	0.262***	0.209	0.246***	0.141
	(0.069)	(0.458)	(0.069)	(0.458)	(0.069)	(0.457)	(0.074)	(0.535)	(0.074)	(0.535)	(0.074)	(0.529)
Constant	-0.496	2.475	-1.296*	1.414	-1.811**	1.056	1.107	2.497	-0.612	1.265	-1.026	0.785
	(0.800)	(1.832)	(0.706)	(1.651)	(0.711)	(1.655)	(0.864)	(2.151)	(0.747)	(1.865)	(0.749)	(1.842)
Observations	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379
R-squared	0.123	0.154	0.124	0.151	0.128	0.155	0.049	0.027	0.046	0.028	0.048	0.025

Note: Individuals of age group 18 to 34 have been included in the analysis. Gender dummy takes a value of 1 if male and 0 if female. Body mass index is weight (in kilograms) by height (in meters) square. US born dummy takes a value 1 if the respondent is born in US, zero otherwise. Employment status takes a value 1 if the respondent is currently working, and zero otherwise. Log real income is the annual household income measured in thousand dollars in 2005 prices. See notes to Table 2.

Appendix Table 4: Regression estimates for symptoms of mental health problem with full set of controls

	Suicide thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.108*** **	**-0.115***					-0.021	-0.073				
	(0.030)	**(0.059)**					(0.029)	(0.052)				
Hours of sleep squared	**0.006*** **	**0.007***					0.001	0.005				
	(0.002)	**(0.004)**					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.062*** **	**-0.067***					-0.011	-0.028		
			(0.018)	**(0.035)**					(0.016)	(0.029)		
More than 8 hours			**-0.069*** **	**-0.072****					-0.016	**-0.052***		
			(0.019)	**(0.037)**					(0.016)	**(0.032)**		
Wald Statistics			0.85	0.15					0.21	2.43		
p-Value			0.356	0.700					0.645	0.120		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.020****	-0.004					**0.024****	0.012
					(0.008)	(0.015)					**(0.009)**	(0.017)
01:00 – 03:00					**0.072*** **	**0.072****					**0.056*** **	**0.054***
					(0.016)	**(0.030)**					**(0.017)**	**(0.029)**
Wald Statistics					**12.03*** **	**8.81****					**4.24****	**2.72***
p-Value					**0.001**	**0.003**					**0.040**	**0.099**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.020****	**-0.032***					0.000	-0.001
					(0.009)	**(0.018)**					(0.010)	(0.018)
08:00 – 10:00					-0.012	-0.022					0.010	-0.009
					(0.014)	(0.025)					(0.016)	(0.029)
Wald Statistics					0.50	0.26					0.56	0.11
p-Value					0.481	0.607					0.456	0.745
Age	-0.053***	-0.031	-0.052***	-0.031	-0.049***	-0.029	-0.035**	-0.035	-0.034**	-0.036	-0.031*	-0.034
	(0.015)	(0.026)	(0.015)	(0.026)	(0.015)	(0.026)	(0.017)	(0.034)	(0.017)	(0.034)	(0.017)	(0.034)
Adjusted age squared	0.093***	0.112***	0.091***	0.110***	0.088***	0.107***	0.063*	0.051	0.062*	0.050	0.058*	0.049
	(0.028)	(0.035)	(0.028)	(0.035)	(0.028)	(0.034)	(0.032)	(0.040)	(0.033)	(0.040)	(0.032)	(0.040)
Gender (Ref: Female)	0.000		0.002		-0.001		-0.040***		-0.040***		-0.044***	
	(0.008)		(0.008)		(0.008)		(0.009)		(0.009)		(0.009)	

Household size	-0.012	0.004	-0.011	0.004	-0.011	0.004	0.003	0.019*	0.003	0.018*	0.003	0.018*
	(0.008)	(0.011)	(0.008)	(0.011)	(0.008)	(0.011)	(0.007)	(0.011)	(0.007)	(0.011)	(0.007)	(0.011)
Household size squared	0.002	0.001	0.002	0.001	0.002	0.001	-0.000	-0.001	-0.000	-0.001	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Body Mass Index (BMI)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.003	-0.001	0.003	-0.001	0.003
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
Ethnicity (Ref: White)												
Black or African	-0.018*	0.029	-0.017*	0.028	-0.016*	0.035	-0.057***	-0.088	-0.057***	-0.090	-0.059***	-0.088
American	(0.009)	(0.124)	(0.009)	(0.124)	(0.009)	(0.125)	(0.009)	(0.100)	(0.009)	(0.098)	(0.009)	(0.101)
American Indian or	-0.010	-0.003	-0.010	0.001	-0.009	0.009	0.045	0.122	0.045	0.125	0.044	0.122
Alaska Native	(0.035)	(0.089)	(0.035)	(0.089)	(0.036)	(0.090)	(0.054)	(0.086)	(0.054)	(0.085)	(0.054)	(0.086)
Asian or Pacific Islander	0.001	0.218**	0.003	0.215**	0.001	0.222*	-0.051***	-0.121	-0.050***	-0.117	-0.055***	-0.122
	(0.023)	(0.107)	(0.023)	(0.105)	(0.023)	(0.113)	(0.018)	(0.091)	(0.018)	(0.091)	(0.018)	(0.088)
US born (Ref: No)	-0.005	0.103	-0.003	0.101	-0.001	0.105	0.022	0.014	0.022	0.016	0.024	0.017
	(0.020)	(0.090)	(0.020)	(0.090)	(0.020)	(0.087)	(0.017)	(0.077)	(0.017)	(0.076)	(0.017)	(0.077)
Level of education (Ref: Not completely bachelor's degree)	-0.005	0.011	-0.005	0.011	-0.007	0.014	0.026**	-0.014	0.026**	-0.013	0.024**	-0.010
	(0.009)	(0.022)	(0.009)	(0.022)	(0.009)	(0.022)	(0.011)	(0.027)	(0.011)	(0.027)	(0.011)	(0.028)
Log real annual income	-0.008*	0.001	-0.008*	0.001	-0.007	0.002	-0.003	0.019**	-0.003	0.020**	-0.002	0.020**
	(0.005)	(0.008)	(0.005)	(0.008)	(0.005)	(0.008)	(0.005)	(0.009)	(0.005)	(0.009)	(0.005)	(0.009)
Employment status (Ref: Currently not employed)	-0.012	0.050***	-0.013	0.050***	-0.010	0.050***	-0.020*	-0.008	-0.020*	-0.012	-0.016	-0.008
	(0.010)	(0.018)	(0.010)	(0.018)	(0.010)	(0.017)	(0.011)	(0.019)	(0.011)	(0.019)	(0.011)	(0.019)
Season (Ref: Winter)												
Spring	-0.003	-0.008	-0.002	-0.006	-0.001	-0.004	-0.019	-0.011	-0.019	-0.011	-0.018	-0.009
	(0.011)	(0.018)	(0.010)	(0.017)	(0.010)	(0.017)	(0.013)	(0.020)	(0.013)	(0.020)	(0.013)	(0.020)
Summer	-0.009	-0.003	-0.009	-0.003	-0.010	-0.005	-0.025*	-0.012	-0.025*	-0.013	-0.027**	-0.013
	(0.011)	(0.020)	(0.011)	(0.020)	(0.011)	(0.020)	(0.013)	(0.023)	(0.013)	(0.023)	(0.013)	(0.023)
Autumn	-0.001	-0.002	-0.000	-0.001	0.000	-0.001	-0.013	0.002	-0.013	-0.000	-0.014	0.000
	(0.011)	(0.019)	(0.011)	(0.019)	(0.011)	(0.019)	(0.012)	(0.021)	(0.012)	(0.021)	(0.012)	(0.021)
Wave (Ref: Wave III)	0.057***	-0.184	0.057***	-0.183	0.052***	-0.189	0.059***	0.070	0.059***	0.078	0.056***	0.064
	(0.017)	(0.128)	(0.017)	(0.128)	(0.017)	(0.128)	(0.020)	(0.173)	(0.020)	(0.172)	(0.020)	(0.171)
Constant	1.292***	0.522	0.896***	0.122	0.779***	0.035	0.675***	0.715	0.600***	0.502	0.505**	0.395
	(0.224)	(0.554)	(0.201)	(0.495)	(0.198)	(0.489)	(0.236)	(0.647)	(0.214)	(0.621)	(0.215)	(0.619)
Observations	4,339	4,339	4,339	4,339	4,339	4,339	4,377	4,377	4,377	4,377	4,377	4,377
R-squared	0.016	0.037	0.013	0.036	0.017	0.044	0.023	0.027	0.023	0.029	0.027	0.028

Note: See notes to Appendix Table 2.

Appendix Table 5: Regression results for general and mental health using balanced panel

	z-score of Self-assessed Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.309****	**-0.332***					**-0.547*****	-0.351				
	(0.148)	**(0.182)**					**(0.169)**	(0.233)				
Hours of sleep squared	**0.020****	**0.024****					**0.033*****	0.020				
	(0.010)	**(0.012)**					**(0.011)**	(0.015)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.192****	-0.084					**-0.318*****	**-0.285****		
			(0.077)	(0.095)					**(0.095)**	**(0.120)**		
More than 8 hours			**-0.165****	-0.031					**-0.323*****	**-0.308****		
			(0.080)	(0.099)					**(0.097)**	**(0.130)**		
Wald Statistics			0.48	1.25					0.02	0.20		
p-Value			0.489	0.264					0.900	0.658		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					0.049	-0.058					**0.097****	0.017
					(0.043)	(0.054)					**(0.044)**	(0.057)
01:00 – 03:00					**0.123***	0.036					**0.265*****	**0.214***
					(0.073)	(0.091)					**(0.084)**	**(0.115)**
Wald Statistics					1.35	1.48					**4.75****	**3.39***
p-Value					0.246	0.224					**0.029**	**0.066**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.098****	**0.131****					-0.041	-0.016
					(0.048)	**(0.060)**					(0.049)	(0.061)
08:00 – 10:00					**0.122***	**0.148***					-0.079	-0.108
					(0.069)	**(0.086)**					(0.074)	(0.099)
Wald Statistics					0.20	0.07					0.41	1.24
p-Value					0.651	0.785					0.524	0.266
Observations	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602
R-squared	0.131	0.154	0.131	0.151	0.133	0.155	0.049	0.027	0.047	0.028	0.046	0.025

Note: Only those individuals have been included in the analysis who responded to all the questions (of our variables of interest) in both the waves. See notes to Table 2.

Appendix Table 6: Regression results for suicide thought and counseling using balanced panel

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.154*** **	**-0.115***					-0.067	-0.073				
	(0.043)	**(0.059)**					(0.045)	(0.052)				
Hours of sleep squared	**0.009*** **	**0.007***					0.004	0.005				
	(0.003)	**(0.004)**					(0.003)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.093*** **	**-0.067***					-0.034	-0.028		
			(0.027)	**(0.035)**					(0.023)	(0.029)		
More than 8 hours			**-0.109*** **	**-0.072****					-0.034	**-0.052***		
			(0.028)	**(0.037)**					(0.023)	**(0.032)**		
Wald Statistics			2.70	0.15					0.00	2.43		
p-Value			0.100	0.700					0.967	0.120		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.017***	-0.004					**0.026****	0.012
					(0.010)	(0.015)					**(0.012)**	(0.017)
01:00 – 03:00					**0.088*** **	**0.072****					**0.061*** **	**0.054***
					(0.022)	**(0.030)**					**(0.023)**	**(0.029)**
Wald Statistics					**11.69*** **	**8.78****					2.67	2.71
p-Value					**0.000**	**0.003**					0.102	0.100
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.027****	**-0.032***					0.011	-0.001
					(0.012)	**(0.018)**					(0.012)	(0.018)
08:00 – 10:00					-0.020	-0.022					0.022	-0.009
					(0.018)	(0.025)					(0.020)	(0.029)
Wald Statistics					0.22	0.26					0.41	0.11
p-Value					0.637	0.608					0.524	0.746
Observations	2,556	2,556	2,556	2,556	2,556	2,556	2,602	2,602	2,602	2,602	2,602	2,602
R-squared	0.026	0.037	0.023	0.036	0.024	0.044	0.023	0.027	0.022	0.029	0.028	0.028

Note: Only those individuals have been included in the analysis who responded to all the questions (of our variables of interest) in both the waves. See notes to Table 2.

Appendix Table 7: Regression estimates with weekend controls

	z-score of General Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Sleep hours (weekdays)	-0.167	**-0.322***					**-0.428*****	-0.360				
	(0.105)	**(0.181)**					**(0.118)**	(0.233)				
Sleep hours squared (weekdays)	0.010	**0.024****					**0.027*****	0.021				
	(0.007)	**(0.012)**					**(0.008)**	(0.015)				
Sleep hours (weekend)	**-0.145****	-0.022					**-0.256*****	-0.080				
	(0.065)	(0.132)					**(0.079)**	(0.149)				
Sleep hours squared (weekend)	**0.009****	0.000					**0.014*****	0.004				
	(0.004)	(0.008)					**(0.005)**	(0.008)				
Sleep hours (weekdays) (Ref: less than 6)												
6 – 8 hours			**-0.123****	-0.065					**-0.207*****	**-0.299****		
			(0.057)	(0.098)					**(0.067)**	**(0.125)**		
More than 8 hours			**-0.167*****	-0.011					**-0.243*****	**-0.328****		
			(0.059)	(0.102)					**(0.069)**	**(0.134)**		
Wald Statistics			1.98	1.31					1.32	0.32		
p-Value			0.160	0.253					0.251	0.574		
Sleep hours (weekend) (Ref: less than 6)												
6 – 8 hours			0.119	0.099					**0.188***	0.114		
			(0.092)	(0.168)					**(0.106)**	(0.187)		
More than 8 hours			-0.002	-0.013					-0.033	0.034		
			(0.035)	(0.055)					(0.038)	(0.064)		
Wald Statistics			1.81	0.46					**4.65**	0.19		
p-Value			0.179	0.499					**0.031**	0.666		
Sleep time on weekdays (Ref: 20:00 – 23:00)												
23:00 – 01:00					0.025	-0.059					**0.150*****	-0.062
					(0.042)	(0.084)					**(0.043)**	(0.079)
01:00 – 03:00					0.060	0.060					**0.178***	0.307
					(0.090)	(0.165)					**(0.104)**	(0.209)
Wald Statistics					0.18	0.070					0.08	**3.41**
p-Value					0.674	0.403					0.773	**0.065**

Wake up time on weekdays (Ref: 04:00 – 06:00)												
06:00 – 08:00					0.048	**0.213****					**-0.095****	-0.013
					(0.044)	**(0.086)**					**(0.046)**	(0.064)
08:00 -10:00					0.019	**0.297****					-0.128	-0.203
					(0.073)	**(0.144)**					(0.080)	(0.165)
Wald Statistics					0.22	0.56					0.24	1.61
p-Value					0.638	0.455					0.627	0.205
Sleep time on weekend (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.109****	-0.025					-0.026	-0.088
					(0.053)	(0.095)					(0.054)	(0.109)
01:00 – 03:00					**0.154****	-0.105					0.027	0.113
					(0.071)	(0.138)					(0.074)	(0.160)
Wald Statistics					0.80	0.63					0.95	**3.57**
p-Value					0.370	0.428					0.329	**0.059**
Wake up time on weekend (Ref: 04:00 – 06:00)												
06:00 – 08:00					0.069	0.057					0.021	-0.083
					(0.071)	(0.127)					(0.065)	(0.105)
08:00 -10:00					0.011	-0.012					0.021	0.028
					(0.069)	(0.130)					(0.065)	(0.127)
Wald Statistics					1.72	0.68					0.00	1.32
p-Value					0.190	0.411					0.989	0.250
Observations	4,358	4,358	4,358	4,358	2,766	2,766	4,358	4,358	4,358	4,358	2,766	2,766
R-squared	0.125	0.155	0.125	0.151	0.150	0.204	0.052	0.029	0.048	0.030	0.044	0.053

Note: See notes to Table 2.

Appendix Table 8: Regression estimates with weekend controls

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Sleep hours (weekdays)	**-0.096*** **	**-0.114***					-0.017	-0.079				
	(0.030)	**(0.059)**					(0.029)	(0.052)				
Sleep hours squared (weekdays)	**0.006*** **	**0.007***					0.001	0.005				
	(0.002)	**(0.004)**					(0.002)	(0.004)				
Sleep hours (weekend)	**-0.050** **	-0.051					-0.026	-0.027				
	(0.021)	(0.038)					(0.019)	(0.044)				
Sleep hours squared (weekend)	**0.003** **	0.003					0.001	0.002				
	(0.001)	(0.002)					(0.001)	(0.003)				
Sleep hours (weekdays) (Ref: less than 6)												
6 – 8 hours			**-0.060*** **	**-0.078** **					-0.013	-0.037		
			(0.018)	**(0.035)**					(0.017)	(0.030)		
More than 8 hours			**-0.062*** **	**-0.083** **					-0.014	**-0.060***		
			(0.019)	**(0.036)**					(0.017)	**(0.033)**		
Wald Statistics			0.06	0.12					0.02	2.31		
p-Value			0.806	0.279					0.888	0.145		
Sleep hours (weekend) (Ref: less than 6)												
6 – 8 hours			0.006	-0.015					-0.004	0.000		
			(0.026)	(0.051)					(0.025)	(0.049)		
More than 8 hours			**-0.024** **	-0.001					-0.016	-0.010		
			(0.010)	(0.016)					(0.011)	(0.020)		
Wald Statistics			1.33	0.08					0.23	0.04		
p-Value			0.248	0.775					0.629	0.838		
Sleep time on weekdays (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.017***	-0.022					**0.032** **	0.023
					(0.010)	(0.020)					**(0.013)**	(0.024)
01:00 – 03:00					0.034	0.040					**0.054** **	0.076
					(0.024)	(0.044)					**(0.027)**	(0.058)
Wald Statistics					0.51	2.58					0.72	1.01
p-Value					0.475	0.109					0.395	0.314
Wake up time on weekdays (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.013	-0.003					-0.006	-0.022
					(0.010)	(0.022)					(0.012)	(0.022)
08:00 -10:00					-0.006	0.008					-0.013	**-0.088***

					(0.019)	(0.038)					(0.022)	**(0.050)**
Wald Statistics					0.19	0.15					0.10	2.23
p-Value					0.663	0.702					0.747	0.135
Sleep time on weekend (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.010	-0.020					**0.039*** **	0.038
					(0.012)	(0.022)					**(0.014)**	(0.027)
01:00 – 03:00					0.016	0.014					**0.034***	0.048
					(0.017)	(0.031)					**(0.018)**	(0.037)
Wald Statistics					**4.36**	2.63					0.14	0.11
p-Value					**0.037**	0.105					0.707	0.741
Wake up time on weekend (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.016	0.011					0.011	-0.005
					(0.016)	(0.020)					(0.018)	(0.030)
08:00 -10:00					-0.005	**0.040***					0.006	0.009
					(0.016)	**(0.022)**					(0.017)	(0.030)
Wald Statistics					1.44	2.07					0.19	0.27
p-Value					0.230	0.150					0.665	0.606
Observations	4,318	4,318	4,318	4,318	2,745	2,745	4,356	4,356	4,356	4,356	2,765	2,765
R-squared	0.018	0.042	0.015	0.040	0.014	0.062	0.024	0.027	0.023	0.028	0.035	0.068

Note: See notes to Table 2.

Appendix Table 9: Regression estimates with additional controls

	z-score of General Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.213***	-0.269					**-0.429*****	**-0.480***				
	(0.113)	(0.231)					**(0.132)**	**(0.284)**				
Hours of sleep squared	0.012	0.018					**0.026*****	0.029				
	(0.008)	(0.016)					**(0.009)**	(0.018)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.145****	**-0.174***					**-0.200*****	**-0.279****		
			(0.059)	**(0.105)**					**(0.068)**	**(0.139)**		
More than 8 hours			**-0.192*****	-0.140					**-0.257*****	**-0.327****		
			(0.060)	(0.108)					**(0.069)**	**(0.149)**		
Wald Statistics			2.21	0.46					**3.05**	0.68		
p-Value			0.137	0.498					**0.081**	0.410		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.099*****	-0.040					**0.143*****	-0.020
					(0.034)	(0.059)					**(0.035)**	(0.058)
01:00 – 03:00					**0.290*****	0.091					**0.256*****	0.164
					(0.058)	(0.103)					**(0.065)**	(0.139)
Wald Statistics					**13.28**	2.12					**3.65**	1.96
p-Value					**0.000**	0.146					**0.056**	0.161
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					0.052	0.079					**-0.074***	-0.055
					(0.038)	(0.066)					**(0.039)**	(0.065)
08:00 – 10:00					0.068	0.026					-0.081	-0.039
					(0.055)	(0.097)					(0.061)	(0.115)
Wald Statistics					0.11	0.50					0.02	0.03
p-Value					0.736	0.478					0.880	0.873
Observations	3,825	3,825	3,825	3,825	3,825	3,825	3,825	3,825	3,825	3,825	3,825	3,825
R-squared	0.154	0.179	0.154	0.180	0.160	0.180	0.063	0.038	0.061	0.039	0.063	0.035

Note: The following additional controls have been used: whether missed work (a dummy variable which takes the value 1 if in the past 30 days, a respondent missed work due to a health problem, 0 otherwise), has morning shift work (a dummy variable which took the value 1 if the respondent was employed in a regular morning shift job (from 8(/9) am to 5(/6) pm), 0 otherwise), has children below six (a binary variable which denoted whether the respondent had any child in the house below the age of 6 years) and incidence of physical activity (i.e., in the past 7 days, whether the respondent did any kind of physical activity, for example did (s)he bicycle, skateboard, dance, hike, hunt, roller blade,

roller skate, downhill ski, snow board, play racquet sports or do aerobics; did strenuous team sports such as football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey, play golf, did fishing, bowling, or play softball or baseball, or did walk as a form of exercise). See notes to Table 2.

Appendix Table 10: Regression estimates with additional controls

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.106*** **	**-0.157** **					0.006	**-0.097* **				
	(0.033)	**(0.076)**					(0.032)	**(0.058)**				
Hours of sleep squared	**0.006*** **	**0.009* **					-0.001	0.006				
	(0.002)	**(0.005)**					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.065*** **	-0.062					-0.012	-0.047		
			(0.020)	(0.039)					(0.017)	(0.031)		
More than 8 hours			**-0.076*** **	**-0.081** **					-0.020	**-0.077** **		
			(0.020)	**(0.041)**					(0.018)	**(0.035)**		
Wald Statistics			1.77	1.57					0.65	2.64		
p-Value			0.184	0.210					0.419	0.104		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.022*** **	0.008					**0.023** **	0.024
					(0.009)	(0.017)					**(0.010)**	(0.017)
01:00 – 03:00					**0.082*** **	**0.105*** **					**0.060*** **	**0.061* **
					(0.018)	**(0.036)**					**(0.018)**	**(0.035)**
Wald Statistics					**12.74**	**9.07**					**4.80**	1.36
p-Value					**0.000**	**0.003**					**0.029**	0.244
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.022** **	**-0.035* **					-0.004	-0.005
					(0.010)	**(0.019)**					(0.010)	(0.020)
08:00 – 10:00					-0.022	-0.012					-0.001	-0.028
					(0.015)	(0.028)					(0.017)	(0.034)
Wald Statistics					0.00	1.04					0.06	0.59
p-Value					0.984	0.307					0.803	0.441
Observations	3,795	3,795	3,795	3,795	3,795	3,795	3,823	3,823	3,823	3,823	3,823	3,823
R-squared	0.021	0.048	0.019	0.043	0.022	0.057	0.039	0.048	0.039	0.050	0.043	0.048

Note: See notes to Appendix Table 9.

Appendix Table 11: Regression estimates with lagged outcome variables as additional controls

VARIABLES	z-score of General Health						z-score of Mental Health					
Hours of sleep	**-0.240****	**-0.547*****					**-0.425*****	-0.063				
	(0.106)	**(0.176)**					**(0.125)**	(0.231)				
Hours of sleep squared	**0.015****	**0.037*****					**0.025*****	0.002				
	(0.007)	**(0.012)**					**(0.008)**	(0.015)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.122****	**-0.166***					**-0.191*****	-0.116		
			(0.059)	**(0.095)**					**(0.069)**	(0.107)		
More than 8 hours			**-0.160*****	-0.153					**-0.261*****	-0.130		
			(0.059)	(0.098)					**(0.070)**	(0.116)		
Wald Statistics			1.57	0.08					4.79	0.09		
p-Value			0.210	0.774					0.029	0.770		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					0.048	-0.043					**0.119*****	0.083
					(0.033)	(0.054)					**(0.034)**	(0.055)
01:00 – 03:00					**0.207*****	0.059					**0.254*****	0.161
					(0.054)	(0.091)					**(0.062)**	(0.108)
Wald Statistics					**10.55**	1.69					**5.27**	0.65
p-Value					**0.001**	0.194					**0.022**	0.419
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					0.052	0.058					-0.062	0.004
					(0.038)	(0.060)					(0.039)	(0.062)
08:00 – 10:00					0.029	0.080					-0.073	-0.073
					(0.053)	(0.087)					(0.059)	(0.091)
Wald Statistics					0.31	0.11					0.06	1.15
p-Value					0.580	0.735					0.812	0.283
Observations	3,858	3,858	3,858	3,858	3,858	3,858	3,857	3,857	3,857	3,857	3,857	3,857
R-squared	0.211	0.293	0.211	0.286	0.214	0.286	0.117	0.332	0.115	0.332	0.116	0.334

Note: See notes to Table 2.

Appendix Table 12: Regression estimates with lagged outcome variables as additional controls

VARIABLES	Suicide Thoughts						Counseling					
Hours of sleep	**-0.106*** **	-0.086					-0.028	-0.046				
	(0.033)	(0.068)					(0.031)	(0.056)				
Hours of sleep squared	**0.006*** **	0.004					0.002	0.002				
	(0.002)	(0.004)					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.062*** **	**-0.068***					-0.012	-0.023		
			(0.021)	**(0.037)**					(0.017)	(0.031)		
More than 8 hours			**-0.066*** **	**-0.089** **					-0.017	**-0.076** **		
			(0.021)	**(0.038)**					(0.017)	**(0.032)**		
Wald Statistics			0.22	2.33					0.26	**11.03**		
p-Value			0.640	0.127					0.607	**0.001**		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.016***	0.018					**0.023** **	**0.035** **
					(0.009)	(0.016)					**(0.010)**	**(0.017)**
01:00 – 03:00					**0.070*** **	**0.103*** **					**0.054*** **	**0.083*** **
					(0.017)	**(0.032)**					**(0.017)**	**(0.031)**
Wald Statistics					**10.71**	**8.84**					**3.80**	**3.56**
p-Value					**0.001**	**0.003**					**0.051**	**0.059**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.021** **	**-0.040** **					0.002	-0.011
					(0.010)	**(0.018)**					(0.011)	(0.018)
08:00 – 10:00					-0.015	**-0.056** **					0.014	-0.044
					(0.015)	**(0.025)**					(0.017)	(0.029)
Wald Statistics					0.26	0.76					0.65	1.89
p-Value					0.610	0.385					0.420	0.169
Observations	3,769	3,769	3,769	3,769	3,769	3,769	3,856	3,856	3,856	3,856	3,856	3,856
R-squared	0.040	0.175	0.038	0.172	0.041	0.180	0.048	0.201	0.048	0.207	0.053	0.204

Note: See notes to Table 2.

Appendix Table 13: Regression estimates using instrument variable approach

Regression estimates for IV estimation	z-score of General Health			z-score of Mental Health			Suicide Thoughts			Counselling		
Hours of sleep	**-0.127***			-0.063			-0.006			0.015		
	(0.070)			(0.076)			(0.018)			(0.021)		
Hours of sleep (Ref: Sleeps less than 6 hours)												
Sleep at least 6 hours		**-1.266****			-0.514			-0.070			0.050	
		(0.620)			(0.622)			(0.145)			(0.167)	
Sleep Pattern (Ref: Early to bed and early to rise (Yes))												
No			0.220			**1.086****			**0.331*****			**0.268****
			(0.392)			**(0.443)**			**(0.115)**			**(0.128)**
Observations	3,843	3,843	3,908	3,843	3,843	3,908	3,817	3,817	3,880	3,842	3,842	3,906
Cragg-Donald Wald F statistic	138.452	38.497	33.092	138.452	38.497	33.092	138.337	40.111	34.115	137.650	38.668	32.889
Kleibergen-Paap rk Wald F statistic	130.884	27.207	32.794	130.884	27.207	32.794	128.659	28.146	33.706	130.143	27.311	32.589

Note: "Early to bed and early to rise" is a binary dummy variable which takes the value 1 if an individual goes to bed between 20:00 and 23:00 and wakes up before 08:00 and takes the value 0 if an individual sleep after 23:00 and wakes up after 08:00. The lag of sleep hours, wake up time and sleep time has been taken as an IV for sleep hours, wake up time and sleep time, respectively. In the baseline regression (Table 1 through 6) analysis, we use data from Wave 3 and Wave 4. The lag of sleep duration and sleep pattern for wave 4 is the sleep duration and sleep pattern recorded for the individuals in wave 3, respectively; while the lag of the sleep duration and sleep pattern in wave 3 is the sleep duration and sleep pattern recorded in wave 2, respectively. See notes to Table 2.

EXTRA TABLES (NOT FOR PUBLICATION)
(SHALL BE MADE AVAILABLE ON REQUEST)

Extra Table 1: Regression results for general and mental health

	z-score of Self-assessed Health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.262****	**-0.332***					**-0.482*****	-0.350				
	(0.105)	**(0.183)**					**(0.120)**	(0.230)				
Hours of sleep squared	**0.016****	**0.024****					**0.030*****	0.020				
	(0.007)	**(0.012)**					**(0.008)**	(0.015)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.156*****	-0.090					**-0.225*****	**-0.283****		
			(0.057)	(0.095)					**(0.066)**	**(0.119)**		
More than 8 hours			**-0.194*****	-0.038					**-0.269*****	**-0.306****		
			(0.059)	(0.099)					**(0.068)**	**(0.128)**		
Wald Statistics			1.55	1.23					2.06	0.19		
p-Value			0.214	0.268					0.151	0.660		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.077****	-0.052					**0.119*****	0.015
					(0.034)	(0.053)					**(0.034)**	(0.056)
01:00 – 03:00					**0.211*****	0.058					**0.262*****	**0.208***
					(0.054)	(0.090)					**(0.061)**	**(0.115)**
Wald Statistics					**7.62**	2.07					**6.64**	**3.21**
p-Value					**0.006**	0.150					**0.010**	**0.073**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					0.042	**0.139****					**-0.064***	-0.017
					(0.037)	**(0.061)**					**(0.038)**	(0.062)
08:00 – 10:00					0.047	**0.156***					-0.075	-0.109
					(0.053)	**(0.087)**					(0.057)	(0.100)
Wald Statistics					0.01	0.07					0.06	1.25
p-Value					0.905	0.789					0.806	0.264
Observations	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379	4,379
R-squared	0.105	0.152	0.105	0.149	0.108	0.154	0.051	0.027	0.048	0.028	0.050	0.025

Note: The control level of education takes the value 1 if an individual has completed their high school and 0 otherwise. See notes to Table 2.

Extra Table 2: Regression results for suicide thoughts and counseling

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.108*** **	**-0.115** **					-0.016	-0.072				
	(0.030)	**(0.059)**					(0.029)	(0.052)				
Hours of sleep squared	**0.006*** **	**0.007***					0.001	0.005				
	(0.002)	**(0.004)**					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.062*** **	**-0.067***					-0.010	-0.028		
			(0.018)	**(0.035)**					(0.016)	(0.029)		
More than 8 hours			**-0.069*** **	**-0.072** **					-0.015	**-0.052***		
			(0.019)	**(0.037)**					(0.016)	**(0.032)**		
Wald Statistics			0.85	0.14					0.33	2.41		
p-Value			0.357	0.703					0.567	0.120		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.020** **	-0.005					**0.025*** **	0.012
					(0.008)	(0.015)					**(0.009)**	(0.016)
01:00 – 03:00					**0.072*** **	**0.070** **					**0.056*** **	**0.056***
					(0.016)	**(0.029)**					**(0.017)**	**(0.029)**
Wald Statistics					**12.14**	**8.66**					**4.22**	**2.95**
p-Value					**0.000**	**0.003**					**0.040**	**0.086**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.020** **	**-0.032***					0.002	0.001
					(0.009)	**(0.018)**					(0.010)	(0.018)
08:00 – 10:00					-0.012	-0.023					0.012	-0.007
					(0.014)	(0.025)					(0.015)	(0.029)
Wald Statistics					0.50	0.27					0.51	0.11
p-Value					0.479	0.603					0.473	0.738
Observations	4,339	4,339	4,339	4,339	4,339	4,339	4,377	4,377	4,377	4,377	4,377	4,377
R-squared	0.016	0.037	0.014	0.036	0.017	0.044	0.021	0.028	0.021	0.029	0.026	0.029

Note: The control level of education takes the value 1 if an individual has completed their high school and 0 otherwise. See notes to Table 2.

Extra Table 3: Regression results for general and mental health

	z-score of Self-assessed health						z-score of Mental Health					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.258****	**-0.374***					**-0.495*****	-0.340				
	(0.114)	**(0.215)**					**(0.132)**	(0.284)				
Hours of sleep squared	**0.016****	**0.027***					**0.031*****	0.021				
	(0.008)	**(0.015)**					**(0.009)**	(0.019)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.154****	-0.114					**-0.226*****	**-0.260****		
			(0.061)	(0.102)					**(0.070)**	**(0.126)**		
More than 8 hours			**-0.197*****	-0.038					**-0.265*****	-0.223		
			(0.063)	(0.108)					**(0.072)**	(0.138)		
Wald Statistics			1.74	2.00					1.36	0.40		
p-Value			0.187	0.158					0.243	0.525		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.097*****	-0.064					**0.149*****	0.039
					(0.035)	(0.063)					**(0.036)**	(0.066)
01:00 – 03:00					**0.268*****	-0.003					**0.261*****	0.176
					(0.059)	(0.104)					**(0.067)**	(0.138)
Wald Statistics					**10.39**	0.50					**3.36**	1.19
p-Value					**0.001**	0.479					**0.067**	0.276
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.080****	**0.123***					-0.056	0.028
					(0.038)	**(0.067)**					(0.041)	(0.067)
08:00 – 10:00					0.065	**0.167***					-0.073	-0.071
					(0.056)	**(0.101)**					(0.062)	(0.123)
Wald Statistics					0.10	0.34					0.12	0.83
p-Value					0.749	0.557					0.733	0.361
Observations	3,834	3,834	3,834	3,834	3,834	3,834	3,834	3,834	3,834	3,834	3,834	3,834
R-squared	0.133	0.168	0.134	0.165	0.140	0.167	0.054	0.033	0.051	0.036	0.053	0.033

Note: Nearly 12.29% of the sample comprised individuals younger than 21 years of age. These individuals were unlikely to have been able to complete their bachelor's degree. Therefore, in the current regression, we re-run the regression excluding individuals less than 21 years. See notes to Table 2.

Extra Table 4: Regression results for suicide thoughts and counseling

	Suicide Thoughts						Counseling					
Regression estimates	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.125*** **	-0.112					-0.008	-0.046				
	(0.033)	(0.073)					(0.030)	(0.059)				
Hours of sleep squared	**0.008*** **	0.007					0.000	0.003				
	(0.002)	(0.005)					(0.002)	(0.004)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.077*** **	**-0.077** **					-0.025	-0.044		
			(0.020)	**(0.039)**					(0.018)	(0.030)		
More than 8 hours			**-0.079*** **	-0.057					**-0.030***	-0.050		
			(0.020)	(0.041)					**(0.018)**	(0.033)		
Wald Statistics			0.05	1.95					0.23	0.14		
p-Value			0.830	0.162					0.630	0.706		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					**0.022*** **	-0.006					0.030***	0.012
					(0.008)	(0.017)					(0.010)	(0.017)
01:00 – 03:00					**0.069*** **	0.026					0.060***	0.039
					(0.017)	(0.033)					(0.018)	(0.031)
Wald Statistics					**8.49**	1.25					**3.13**	0.86
p-Value					**0.004**	0.264					**0.077**	0.355
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.027*** **	-0.030					-0.006	-0.007
					(0.010)	(0.020)					(0.011)	(0.018)
08:00 – 10:00					-0.024	-0.012					0.002	-0.023
					(0.015)	(0.030)					(0.017)	(0.033)
Wald Statistics					0.07	0.70					0.30	0.32
p-Value					0.791	0.404					0.586	0.569
Observations	3,803	3,803	3,803	3,803	3,803	3,803	3,832	3,832	3,832	3,832	3,832	3,832
R-squared	0.017	0.037	0.015	0.042	0.015	0.038	0.026	0.033	0.027	0.035	0.031	0.034

Note: Nearly 12.29% of the sample comprised individuals younger than 21 years of age. These individuals were unlikely to have been able to complete their bachelor's degree. Therefore, in the current regression, we re-run the regression excluding individuals less than 21 years. See notes to Table 2.

Extra Table 5: Logit results

Regression estimates	Suicide Thoughts						Counseling					
	FE	Logit	FE	Logit	FE	Logit	FE	Logit	FE	Logit	FE	Logit
Hours of sleep	**-0.115***	**-0.071*****					-0.073	-0.020				
	(0.059)	**(0.017)**					(0.052)	(0.025)				
Hours of sleep squared	**0.007***	**0.004*****					0.005	0.001				
	(0.004)	**(0.001)**					(0.004)	(0.002)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.067***	**-0.062*****					-0.028	-0.012		
			(0.035)	**(0.018)**					(0.029)	(0.017)		
More than 8 hours			**-0.072****	**-0.068*****					**-0.052***	-0.017		
			(0.037)	**(0.019)**					**(0.032)**	(0.017)		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.004	**0.019*****					0.012	**0.022*****
					(0.015)	**(0.007)**					(0.017)	**(0.008)**
01:00 – 03:00					**0.072****	**0.070*****					**0.054***	**0.054*****
					(0.030)	**(0.016)**					**(0.029)**	**(0.017)**
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**-0.032***	**-0.021****					-0.001	0.001
					(0.018)	**(0.010)**					(0.018)	(0.010)
08:00 – 10:00					-0.022	-0.015					-0.009	0.008
					(0.025)	(0.013)					(0.029)	(0.014)
Observations	4,339	4,339	4,339	4,339	4,339	4,339	4,377	4,377	4,377	4,377	4,377	4,377
R-squared	0.037		0.036		0.044		0.027		0.029		0.028	

Note: We report the marginal effects of the logit estimates, with clustered standard errors at individual level in parentheses. See notes to Table 2.

Extra Table 6: Regression results with sleep duration and sleep habit in the same regression

Regression estimates	z-score of							
	Self-assessed Health		Mental Health		Suicide Thoughts		Counseling	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Hours of sleep	**-0.202***	**-0.337***	**-0.424*****	-0.333	**-0.087*****	-0.077	0.008	-0.051
	(0.108)	**(0.186)**	**(0.125)**	(0.237)	**(0.032)**	(0.060)	(0.030)	(0.054)
Hours of sleep squared	**0.012***	**0.024***	**0.028*****	0.019	**0.005****	0.005	0.000	0.004
	(0.007)	**(0.012)**	**(0.008)**	(0.015)	**(0.002)**	(0.004)	(0.002)	(0.004)
Sleep time (Ref: 20:00 – 23:00)								
23:00 – 01:00	0.069	-0.038	**0.124*****	-0.041	0.009	-0.010	**0.039*****	0.021
	(0.043)	(0.065)	**(0.043)**	(0.067)	(0.010)	(0.019)	**(0.012)**	(0.020)
01:00 – 03:00	**0.140***	0.055	**0.206****	0.060	**0.038***	0.052	**0.088*****	**0.071***
	(0.083)	(0.127)	**(0.086)**	(0.142)	**(0.022)**	(0.036)	**(0.025)**	**(0.039)**
Wald Statistics	1.41	1.00	1.59	0.75	**2.83**	5.61	**7.04**	**2.83**
p-Value	0.234	0.318	0.208	0.388	**0.092**	0.018	**0.008**	**0.093**
Wake up time (Ref: 04:00 – 06:00)								
06:00 – 08:00	**0.099****	**0.124***	-0.031	0.055	-0.005	-0.023	-0.014	-0.008
	(0.044)	**(0.070)**	(0.045)	(0.072)	(0.011)	(0.020)	(0.013)	(0.022)
08:00 – 10:00	0.126	0.103	-0.045	0.029	0.015	-0.007	-0.021	-0.030
	(0.078)	(0.124)	(0.083)	(0.138)	(0.021)	(0.035)	(0.023)	(0.042)
Wald Statistics	0.27	0.06	0.05	0.07	1.96	0.44	0.21	0.54
p-Value	0.603	0.801	0.818	0.795	0.162	0.506	0.643	0.461
Observations	4,379	4,379	4,379	4,379	4,339	4,339	4,377	4,377
R-squared	0.129	0.158	0.052	0.028	0.019	0.046	0.028	0.030

Note: The current regression includes total sleeping time with the bedtime and waking time dummies. See notes to Table 2.

Extra Table 7: PSM Balance Test

Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>t
Age (in years)	26.538	26.613	-1.9	-0.670	0.505
Adjusted age squared (age square divided by 100)	7.183	7.225	-2.1	-0.720	0.469
Gender dummy (Ref: Female)	0.382	0.376	1.1	0.370	0.711
Household size	2.399	2.439	-2.9	-0.970	0.331
Household size squared	7.646	7.873	-2.2	-0.750	0.454
BMI group (Ref: Normal BMI)	0.589	0.595	-1.1	-0.370	0.710
Ethnicity (Ref: White)					
Black or African American	0.180	0.191	-2.8	-0.930	0.351
American Indian or Alaska Native	0.008	0.007	1.1	0.420	0.678
Asian or Pacific Islander	0.024	0.027	-1.4	-0.530	0.595
US born dummy (Ref: No)	0.958	0.959	-0.3	-0.090	0.928
Level of education (Ref: below high school level)					
Below bachelor's level	0.266	0.263	0.6	0.200	0.838
Bachelors and above	0.701	0.700	0.2	0.070	0.948
Log of real annual income	3.391	3.401	-0.9	-0.300	0.761
Employment status (Ref: Currently not working)	0.877	0.865	3.7	1.170	0.241
Season (Ref: Winter)					
Spring	0.364	0.368	-0.7	-0.220	0.828
Summer	0.209	0.213	-1.1	-0.350	0.724
Autumn	0.218	0.217	0.2	0.070	0.948
Wave III	0.361	0.355	1.3	0.450	0.653
Wave IV	0.639	0.645	-1.3	-0.450	0.653
Children below 6 years of age (Ref: No)	0.427	0.431	-0.8	-0.270	0.785
Work shift (Ref: Regular shift)	0.161	0.162	-0.3	-0.110	0.909
Missed work due to health issues	0.201	0.204	-0.6	-0.200	0.840
Health problems (Ref: No)	0.390	0.387	0.4	0.150	0.884
Financial problems (Ref: No)	0.342	0.358	-1.8	-0.630	0.528

Note: The BMI group is a dummy which takes the value 1 if an individual has BMI which is less than 25 and 0 if BMI is greater than or equal to 25. Missed work due to health issues is a dummy variable which takes the value 1 if in the past 30 days, a respondent missed work due to a health problem, 0 otherwise. Individuals who could do moderate activities (such as moving a table, pushing a vacuum cleaner, bowling and playing golf) and who did not have cancer or lymphoma or leukemia, high blood cholesterol or triglycerides or lipids, high blood pressure or hypertension, high blood sugar or diabetes, depression, epilepsy or another seizure disorder currently or in the past were considered to have no health issues. Individuals (the respondent or their household) who were without phone service, "*didn't pay the full amount of the rent or mortgage*", were evicted from their house or apartment for not paying the rent or mortgage, "*didn't pay the full amount of a gas, electricity, or oil bill"* or *"had the service turned off by the gas or electric company, or the oil company wouldn't deliver*" because they didn't have enough money were considered to have financial problems. See notes to Table 2.

Extra Table 8: Fixed effect regression estimates by weight

Regression estimates	z-score of General Health						z-score of Mental Health					
	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese
Hours of sleep	-0.349	-0.087					**-0.544***	0.547				
	(0.237)	(0.433)					**(0.292)**	(0.427)				
Hours of sleep squared	0.023	0.014					0.031	-0.032				
	(0.016)	(0.030)					(0.019)	(0.029)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			-0.192	-0.254					**-0.494****	0.363		
			(0.119)	(0.247)					**(0.210)**	(0.240)		
More than 8 hours			-0.158	-0.086					**-0.549****	0.444		
			(0.123)	(0.265)					**(0.224)**	(0.297)		
Wald Statistics			0.38	1.13					0.00	0.21		
p-Value			0.537	0.287					0.947	0.646		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.064	-0.210					0.082	-0.115
					(0.065)	(0.134)					(0.059)	(0.180)
01:00 – 03:00					0.049	-0.062					**0.398*****	-0.366
					(0.109)	(0.211)					**(0.139)**	(0.276)
Wald Statistics					1.46	0.62					**5.62****	0.80
p-Value					0.227	0.432					**0.018**	0.373
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.015	**0.431*****					-0.033	-0.042
					(0.075)	**(0.144)**					(0.075)	(0.140)
08:00 – 10:00					0.002	0.329					**-0.241****	-0.196
					(0.105)	(0.274)					**(0.118)**	(0.253)
Wald Statistics					0.05	0.19					**4.38****	0.48
p-Value					0.827	0.663					**0.037**	0.490
Observations	3232	1147	3232	1147	3232	1147	3232	1147	3232	1147	3232	1147
R-squared	0.122	0.255	0.122	0.246	0.121	0.279	0.050	0.105	0.054	0.106	0.049	0.111

Note: According to WHO standards, an Individual is considered to be obese if his/her Body Mass Index is greater than or equal to 30. In our analysis, an individual is non-obese if his/her Body Mass Index is less than 30. We only report the fixed effects regression estimates. See notes to Table 2.

Extra Table 9: Fixed effect regression estimates by weight

Regression estimates	Suicide Thoughts						Counseling					
	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese
Hours of sleep	**-0.192****	-0.009					**-0.118***	0.040				
	(0.076)	(0.135)					**(0.065)**	(0.083)				
Hours of sleep squared	**0.011****	0.002					**0.008***	-0.003				
	(0.005)	(0.008)					**(0.004)**	(0.005)				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.120*****	0.014					-0.043	0.056		
			(0.045)	(0.113)					(0.036)	(0.049)		
More than 8 hours			**-0.138*****	0.071					-0.053	-0.000		
			(0.046)	(0.117)					(0.038)	(0.060)		
Wald Statistics			1.36	4.33					0.25	1.70		
p-Value			0.244	**0.038**					0.616	0.192		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.057	0.007					0.015	0.051
					(0.057)	(0.025)					(0.020)	(0.037)
01:00 – 03:00					0.043	-0.101					0.055	0.064
					(0.097)	(0.083)					(0.039)	(0.065)
Wald Statistics					**17.68*****	1.79					1.25	0.05
p-Value					**0.000**	0.181					0.264	0.823
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.013	-0.022					0.006	0.014
					(0.066)	(0.037)					(0.024)	(0.040)
08:00 – 10:00					0.002	**0.128****					-0.011	-0.075
					(0.031)	**(0.051)**					(0.037)	(0.055)
Wald Statistics					0.34	**7.29****					0.27	2.61
p-Value					0.559	**0.007**					0.601	0.107
Observations	3,198	1,141	3,198	1,141	3,198	1,141	3,230	1,147	3,230	1,147	3,230	1,147
R-squared	0.065	0.121	0.065	0.126	0.077	0.168	0.036	0.115	0.034	0.126	0.035	0.132

Note: We only report the fixed effects regression estimates. See notes to Table 2.

Extra Table 10: Fixed effect regression estimates by gender

Regression estimates	z-score of General Health						z-score of Mental Health					
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Hours of sleep	**-0.502***	0.105					-0.402	**-0.683****				
	(0.258)	(0.254)					(0.341)	**(0.298)**				
Hours of sleep squared	**0.037****	-0.009					0.020	**0.049****				
	(0.017)	(0.018)					(0.022)	**(0.021)**				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			-0.071	-0.082					**-0.494****	-0.139		
			(0.161)	(0.112)					**(0.210)**	(0.125)		
More than 8 hours			-0.002	-0.073					**-0.549****	-0.063		
			(0.164)	(0.123)					**(0.224)**	(0.133)		
Wald Statistics			1.28	0.01					0.55	1.46		
p-Value			0.258	0.907					0.460	0.227		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.096	-0.004					-0.045	0.110
					(0.070)	(0.080)					(0.077)	(0.083)
01:00 – 03:00					-0.079	**0.232***					0.279	0.094
					(0.122)	**(0.131)**					(0.175)	(0.127)
Wald Statistics					0.02	**5.00**					**3.81**	0.02
p-Value					0.875	**0.025**					**0.051**	0.891
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					**0.159***	0.128					-0.112	0.059
					(0.086)	(0.084)					(0.091)	(0.076)
08:00 – 10:00					**0.241***	0.053					**-0.306****	0.157
					(0.123)	(0.118)					**(0.152)**	(0.112)
Wald Statistics					0.85	0.75					2.39	1.17
p-Value					0.356	0.386					0.122	0.280
Observations	2,491	1,888	2,491	1,888	2,491	1,888	2,491	1,888	2,491	1,888	2,491	1,888
R-squared	0.169	0.180	0.158	0.180	0.163	0.191	0.039	0.064	0.040	0.052	0.041	0.058

Note: We only report the fixed effects regression estimates. See notes to Table 2.

Extra Table 11: Fixed effect regression estimates by gender

Regression estimates	Suicide Thoughts						Counseling					
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Hours of sleep	**-0.127***	-0.132					-0.101	-0.116				
	(0.074)	(0.110)					(0.072)	(0.076)				
Hours of sleep squared	0.008	0.009					0.006	**0.009***				
	(0.005)	(0.008)					(0.005)	**(0.005)**				
Hours of sleep (Ref: less than 6 hours)												
6 – 8 hours			**-0.092***	-0.053					-0.051	-0.013		
			(0.052)	(0.046)					(0.040)	(0.039)		
More than 8 hours			**-0.091***	-0.060					**-0.112****	0.022		
			(0.055)	(0.048)					**(0.045)**	(0.041)		
Wald Statistics			0.00	0.10					**7.70****	**3.06***		
p-Value			0.971	0.747					**0.006**	**0.080**		
Sleep time (Ref: 20:00 – 23:00)												
23:00 – 01:00					-0.015	0.019					**0.049****	**-0.040***
					(0.017)	(0.028)					**(0.022)**	**(0.024)**
01:00 – 03:00					**0.075****	0.075					**0.100*****	-0.026
					(0.036)	(0.050)					**(0.039)**	(0.044)
Wald Statistics					**7.25****	1.84					2.23	0.13
p-Value					**0.007**	0.175					0.136	0.715
Wake up time (Ref: 04:00 – 06:00)												
06:00 – 08:00					-0.011	**-0.061****					-0.004	0.002
					(0.023)	**(0.027)**					(0.024)	(0.027)
08:00 – 10:00					-0.009	-0.028					-0.059	0.056
					(0.033)	(0.040)					(0.040)	(0.040)
Wald Statistics					0.01	1.17					2.31	**3.18***
p-Value					0.939	0.280					0.128	**0.075**
Observations	2,474	1,865	2,474	1,865	2,474	1,865	2,490	1,887	2,490	1,887	2,490	1,887
R-squared	0.065	0.038	0.065	0.037	0.071	0.051	0.039	0.055	0.045	0.046	0.043	0.054

Note: We only report the fixed effects regression estimates. See notes to Table 2.