Chronotype and Body Mass Index: Exploring the Sleep-Weight Relationship

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Abstract

Obesity is a global health concern with significant morbidity implications. Emerging evidence suggests a correlation between an individual's chronotype and their body mass index (BMI). In this study, we aim to determine a correlation between these variables by assessing participants' chronotypes using the MCTQ and by measuring their BMI using a digital physician scale and stadiometer. The participants consisted of Thompson Rivers University students aged 18-27, who were fluent in English and did not work night shifts. The results showed a significant positive correlation between BMI and chronotype, indicating that as individuals' chronotypes become later, BMI increases.

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In recent years, obesity has become a global epidemic posing significant challenges to public health. In 2022, one in eight people in the world were diagnosed with obesity and in 2019 alone obesity caused an estimated five million deaths (Obesity and overweight, 2024). While numerous factors contributing to obesity have been well researched, such as diet and exercise, emerging evidence suggests a compelling link between chronotype and body mass index (BMI). BMI is a measurement of body fat based on height and weight, and the World Health Organization defines obesity in adults as a BMI greater than or equal to thirty (Obesity and overweight, 2024). As described by Roenneberg, et al. (2003), a chronotype is an individual's inherent preference for sleep and wakefulness within a twenty-four hour period. It differentiates whether an individual is more active and alert in the morning (morning type) or evening (evening type), and any other in-between types.

A study done by Ermin & Sert (2022) suggests that individuals with evening chronotypes tend to have poor dietary habits and unhealthy eating patterns compared to those with morning chronotypes. Another study by Teixeira, et al. (2022) supports these findings and adds that late chronotypes are prone to eating ultra-processed foods, frequently skipping breakfast, and eating late at night. In contrast, morning types are more inclined towards healthier eating habits such as eating breakfast and prioritizing fresh over processed foods. These unhealthy habits tend to lead individuals towards obesity (Teixeira, et al. 2022).

Determining a correlation between chronotype and BMI carries significant implications for addressing the global obesity epidemic and developing interventions for weight management. In this study, we aim to determine a correlation by assessing the participants' chronotypes using the Munich ChronoType Questionnaire (MCTQ) and by measuring BMI. We hypothesize that participants with later chronotypes will exhibit higher BMIs compared to early chronotypes.

Method

Participants

The participants included 55 students (39 males and 16 females) from Thompson Rivers University between the ages of 18 and 27 years old (M = 20.95 years old, SD = 2.851 years). All participants were fluent in English and did not work night shifts. In exchange for volunteering, each participant was accredited a 2% bonus mark towards the psychology class they were enrolled in.

Materials

Munich ChronoType Questionnaire

The Munich ChronoType Questionnaire assesses an individual's chronotype, which refers to their preferred timing of sleep and wakefulness. Developed by Roenneberg, et al. (2003), it consists of a series of questions regarding bedtime, naptime, and light exposure, differentiating between “free” and “work” days. Additionally, there is a self-rate chronotype category based on a description (0 = extreme early, 1 = moderate early, 2 = slight early, 3 = normal, 4 = slight late, 5 = moder- ate late, 6 = extreme late).

Digital Physician Scale[1] and Stadiometer[2]

The digital physician scale and stadiometer are used to calculate a participant’s weight and height, respectively.

Procedures

We recruited students using the Sona Systems platform[3]. Our study was registered with a brief description explaining the purpose of the study, the approximate time it would take (one hour), eligibility criteria, and the bonus credit students would receive for participating (2%). Participants interested in our study then selected a time slot based on the availability of our study.

The study took place at the TRU psychology lab and each participant was assessed individually. Once the participants arrived they were assured confidentiality (participants were assigned a random number with no record of associated name) and given a consent form including purpose, procedures including the time it will take, risks/benefits, compensation, confidentiality, right to withdraw, and contact information. Participants who did not consent or withdrew from the study were still accredited with the 2% bonus.

The participants were then asked to rate their chronotype using the Munich ChronoType Questionnaire (Roenneberg, et al. 2003). Afterwards, the questionnaires were collected and securely stored in a filing cabinet for confidentiality. Participants then underwent measurements of weight and height using a digital physician scale and stadiometer, respectively. These measurements were carefully recorded under each participant's assigned number for subsequent data analysis and stored in the filing cabinet. Participants were then provided with a debriefing session during which they were given the chance to withdraw their consent or ask any questions they might have had.

Data Analysis

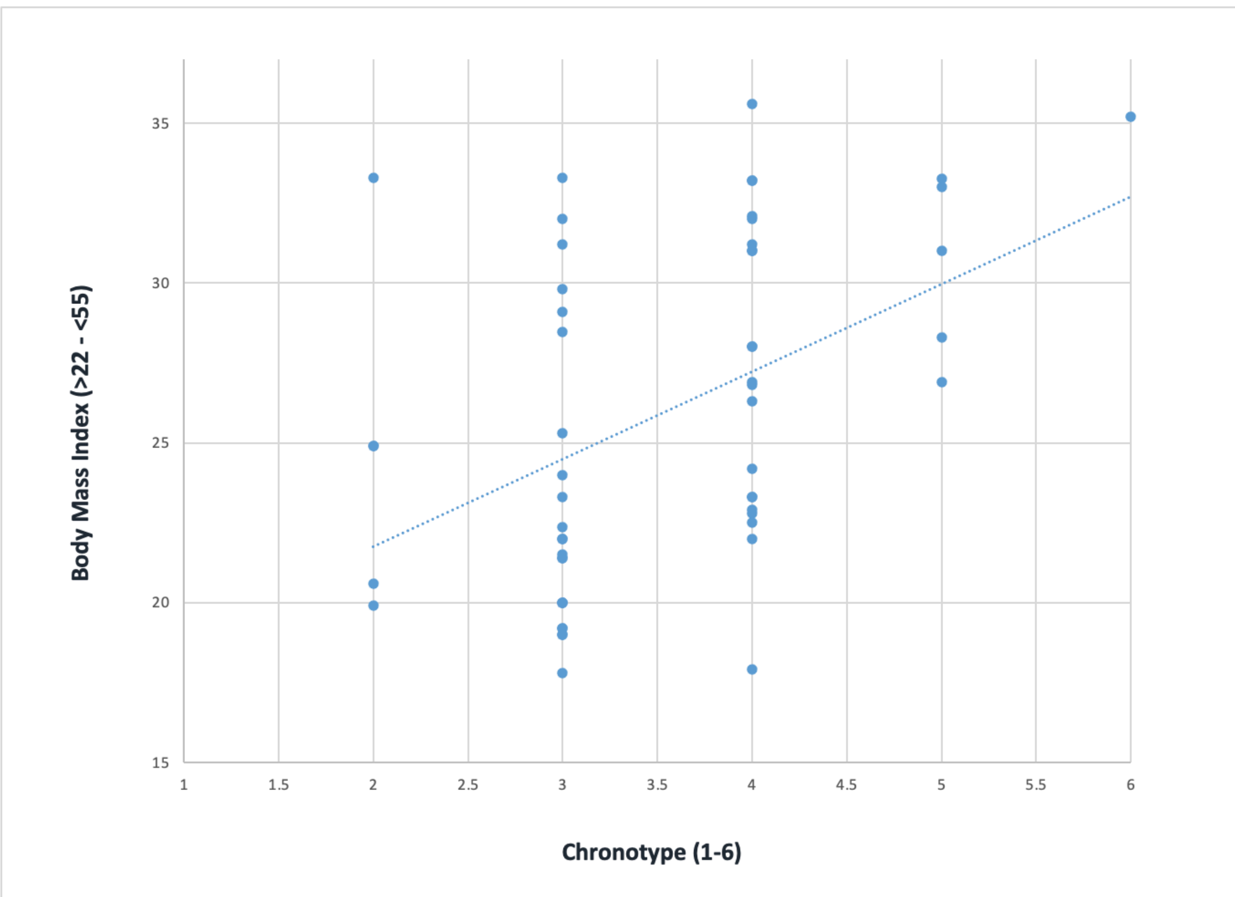
The data obtained from each participant using the digital physician scale and stadiometer were used to calculate BMI, calculated as weight in kilograms divided by height in meters squared (kg/m^2).

Results

Using Pearson's Product Moment Correlation Coefficient to correlate BMI and chronotype, we identified a statistically significant positive correlation between the two variables ($r = 0.5$, $p < 0.05$). This indicates that as the participants' chronotypes shifted later, their BMI increased accordingly (as shown by figure 1).

Figure 1

Changes in BMI in Relation to Chronotype



Discussion

The results of this study support the hypothesis that participants with later chronotypes exhibit higher BMIs compared to early chronotypes. As represented by the trendline in figure 1, as chronotypes shift later (1 → 6), BMI increases. This pattern is supported by previous literature that explains later chronotypes are associated with poor eating habits leading to obesity (Erim & Sert, 2022; Teixera, et al., 2022). Therefore, as chronotypes shift later, eating habits tend to deteriorate resulting in a rise in BMI. However, other variables could have impacted the results such as physical activity levels, socioeconomic status, or psychological factors, which could independently affect both chronotype or BMI.

The study also faced limitations. Using the MCTQ was a cost-effective, easy to administer way to determine participant chronotypes. However, the reliance on self-report allowed biases such as recall error and social desirability, which may have affected the accuracy of the chronotypes. Future studies may benefit from combining the MCTQ with objective measures such as actigraphy or polysomnography.

Understanding that BMI has a positive correlation with chronotype allows for the development of personalized interventions aimed at addressing obesity. Individuals facing this disease might potentially adjust their chronotype to reduce BMI. Future research could investigate this theory by adjusting obese individual’s chronotype to an earlier pattern and subsequently evaluating whether this adjustment results in a reduction of BMI.

References

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