

# Time Perspective and BMI: The Mediating Roles of Self-Control and Sugar-Sweetened Beverage Consumption

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**Objective:** This study aims to investigate the associations between future, present-hedonistic, and present-fatalistic time perspectives (TP) and body mass index (BMI) among college students, and to examine whether self-control and sugar-sweetened beverage (SSB) consumption mediate these relationships.

**Methods:** A cross-sectional survey was conducted in Jiangsu Province, China, involving 920 college students. The survey collected data on participants' height, weight, future TP, present-hedonistic TP, present-fatalistic TP, self-control, and SSB consumption. Multiple hierarchical regression analysis was employed to identify potential covariates, and three chain mediation models were analyzed using the PROCESS macro (Model 6) in SPSS version 26.

**Results:** The results indicated that future TP was negatively associated with BMI ( $\beta = -0.23$ , 95% CI =  $[-3.81, -2.24]$ ), and present-hedonistic TP showed a positive association ( $\beta = 0.18$ , 95% CI =  $[1.47, 2.73]$ ). Present-fatalistic TP was not significantly related to BMI. Furthermore, self-control and SSB consumption mediated the relationships between future TP, present-hedonistic TP, present-fatalistic TP, and BMI ( $\beta = -0.02$ , 95% CI  $[-0.04, -0.01]$ ;  $\beta = 0.02$ , 95% CI  $[0.01, 0.02]$ ;  $\beta = 0.02$ , 95% CI =  $[0.01, 0.02]$ ).

**Conclusion:** TP, self-control, and SSB consumption are important factors associated with BMI among college students. Promoting a future-oriented TP and self-control, while reducing present-oriented TP and SSB intake, may support more effective BMI management. These findings offer theoretical implications for designing targeted health interventions.

**Keywords:** time perspective, self-control, sugar-sweetened beverage, college students, weight gain

## Introduction

Obesity refers to a chronic condition marked by the abnormal accumulation of body fat, which negatively affects health.<sup>1</sup> It is strongly linked to the rising prevalence of cardiovascular diseases,<sup>2</sup> sleep apnea,<sup>3</sup> diabetes, cancer,<sup>4,5</sup> and musculoskeletal disorders,<sup>6</sup> while also imposing a substantial economic burden on individuals and society. Body Mass Index (BMI) is a key indicator of obesity; according to World Health Organization (WHO), a BMI  $\geq 25$  kg/m<sup>2</sup> is considered overweight and  $\geq 30$  kg/m<sup>2</sup> is obese.<sup>7</sup> WHO estimates that nearly 2.5 billion adults globally are overweight, with approximately 890 million of them being obese. Obesity rates are rising among Chinese adults and college students. In 2024, the college student population reached 47.63 million, with recent studies reporting overweight or obesity in 23.5% of males and 11.9% of females.<sup>8</sup> The transition from adolescence to early adulthood is a key period for developing healthy physical habits.<sup>9</sup> Higher BMI levels during this period not only pose immediate health risks but also increase the likelihood of obesity-related diseases and premature mortality in adulthood.<sup>10,11</sup> Therefore, it is crucial to explore the underlying mechanisms influencing BMI, particularly focusing on modifiable psychological and behavioral factors.

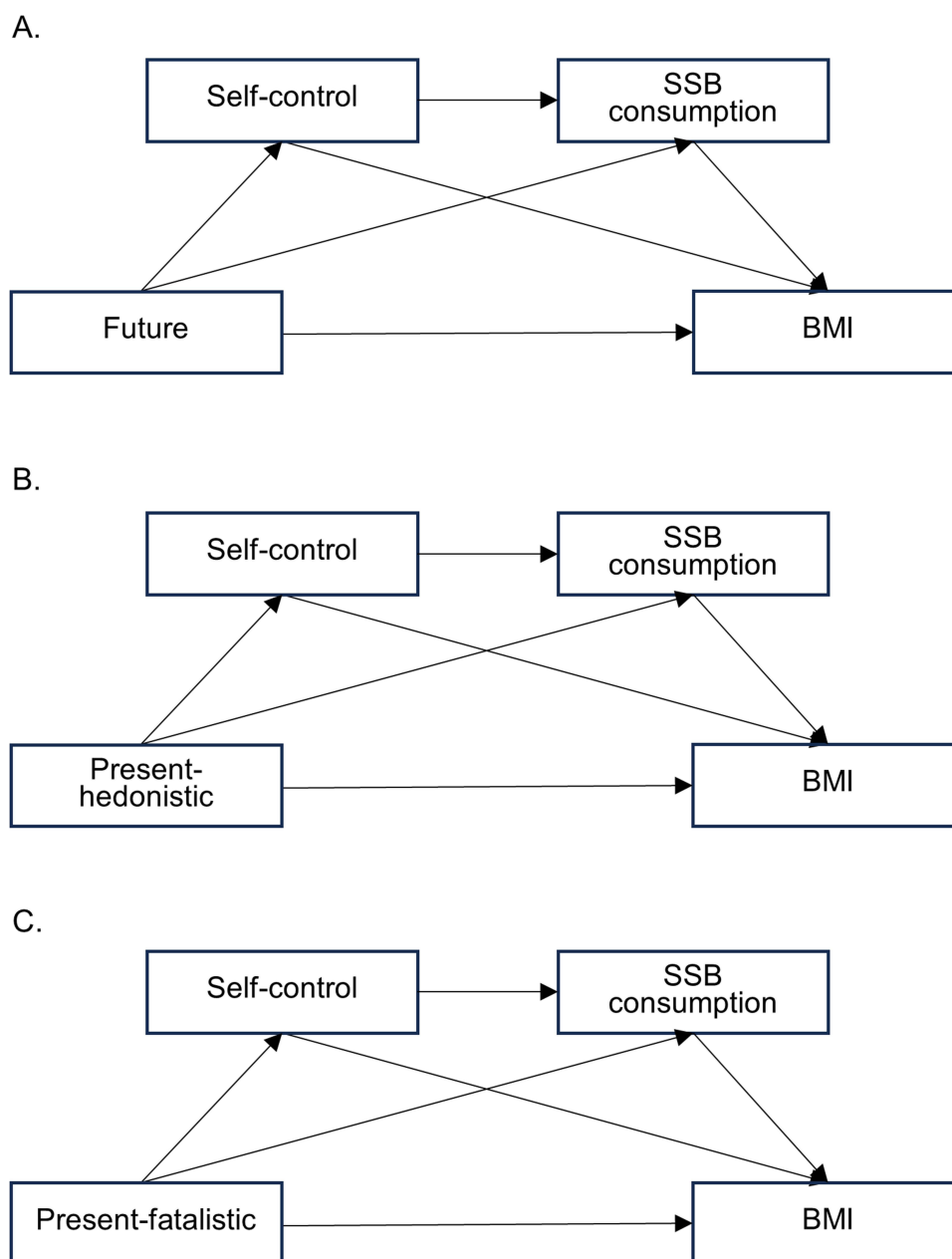
The outcomes of health behaviors often do not manifest immediately but occur after a delay. This suggests that individuals' health-related behaviors are inevitably influenced by their time perspective (TP).<sup>12</sup> Research has shown that specific dimensions of TP are independently associated with BMI.<sup>13–15</sup> Construal level theory also suggests that a future TP enhances psychological distancing from tempting situations. This fosters higher-level cognitive processes and enhances self-control,<sup>16</sup> which ultimately reduces the consumption of high-calorie food, whereas the present TP may have the opposite effect.<sup>17,18</sup> To date, there are no studies that have examined the full sequential pathway from TP to BMI via self-control and health behaviors. This study seeks to examine the relationships among TP, self-control, sugar-sweetened beverage (SSB) consumption, and BMI in college students, with the goal of identifying potential intervention strategies to promote effective BMI management.

TP refers to a psychological construct that describes how individuals perceive and connect with the past, present, and future.<sup>19</sup> It significantly impacts self-awareness, plays a key role in the formation of goals, and influences both decision-making and behavior. In health behavior research, TP is often explored in terms of the present and future.<sup>13,14,20</sup> Zimbardo and Boyd describe the present-hedonistic TP as prioritizing immediate pleasure, often disregarding long-term consequences. The present-fatalistic TP is characterized by a sense of helplessness and resignation toward life. The future TP is associated with planning and striving toward long-term goals.<sup>19</sup> Previous studies indicate that a stronger future TP is associated with a lower BMI,<sup>13,21–23</sup> with some suggesting that health behaviors influence this relationship.<sup>24</sup> However, findings regarding the relationship between present TP and BMI are inconsistent. Some studies report higher present-fatalistic or present-hedonistic tendencies in individuals with elevated BMI,<sup>13,15</sup> while others find no significant associations.<sup>20</sup> Given the inconsistent findings and the limited research specifically focusing on college students, further research is needed to clarify the relationship between TP and BMI among this population.

Self-control is the ability of an individual to regulate their thoughts, behaviors, and emotions in pursuit of long-term goals, overcoming impulses and resisting temptations.<sup>25</sup> Research has demonstrated a significant association between self-control and BMI, with individuals exhibiting higher self-control managing their BMI more effectively.<sup>26,27</sup> Moreover, individuals with higher self-control are better able to resist dietary temptations, thereby reducing the risk of elevated BMI.<sup>28</sup> An individual's TP plays a crucial role in shaping their self-control. Zimbardo and Boyd<sup>19</sup> found that a future TP is positively related to self-control, whereas both present-hedonistic TP and present-fatalistic TP show a negative correlation with self-control. This relationship has been supported by further research.<sup>29–31</sup> The dual-motive model posits that self-control involves balancing two competing motivations, the desire for immediate rewards versus the pursuit of delayed, larger rewards.<sup>32</sup> TP influences self-control by altering the relative appeal of short-term versus long-term goals.

The global consumption of sugar-sweetened beverages (SSBs) has increased steadily in recent years, emerging as a major public health concern.<sup>33</sup> Excessive intake of SSBs has been linked to higher BMI levels and a range of chronic health conditions.<sup>34,35</sup> Alarmingly, 87.6% of adolescents in China consume SSBs, averaging 205.4 milliliters (mL) per day, greatly exceeding the WHO's recommended intake.<sup>36</sup> Understanding the psychological factors underlying this behavior is crucial, and TP may serve as a key explanatory variable. The decision to consume SSBs reflects a trade-off between immediate gratification (eg, taste enjoyment) and long-term health outcomes (eg, maintaining a healthy weight). Given that the adverse health effects of SSBs are delayed, while the rewards are immediate, individuals with different TPs may evaluate this trade-off differently, thereby influencing their consumption behaviors.<sup>37</sup> Research indicates that individuals with a strong future TP are more inclined to participate in health-enhancing activities, including exercise, nutritious eating, and sufficient sleep.<sup>38,39</sup> In contrast, individuals with a strong present TP tend to engage in unhealthy behaviors.<sup>40,41</sup> Furthermore, self-control plays a significant role in SSB consumption. Existing research has validated the relationship between self-control and dietary behaviors through several theoretical models.<sup>42,43</sup> The temporal self-regulation theory suggests that health behaviors are jointly influenced by environmental factors and an individual's self-regulatory abilities.<sup>44</sup> Self-control has been shown to influence a variety of behaviors, including sleep, alcohol consumption, smoking, and SSB intake.<sup>45–49</sup>

In summary, previous research has examined the association between TP and BMI; however, the mediating factors underlying this relationship remain underexplored. In particular, few studies have examined the full sequential pathway from TP to BMI via self-control and health behaviors. To better understand how TPs influence BMI, it is important to investigate the distinct effects of each TP and their respective pathways.



**Figure 1** Hypothetical models (A) Serial mediation model for future time perspective (B) Serial mediation model for present-hedonistic time perspective (C) Serial mediation model for present-fatalistic time perspective.

**Abbreviations:** SSB, sugar-sweetened beverage; BMI, body mass index.

This study examined the associations between TP and BMI in college students through three chain mediation models. Specifically, future, present-hedonistic, and present-fatalistic TPs were included as independent variables, BMI as the dependent variable, and self-control and SSB consumption as sequential mediators. The hypothesized models are shown in Figure 1.

## Material and Methods

### Participates and Procedure

Data were collected employing a cluster sampling method from four universities in Nanjing and Xuzhou, Jiangsu Province, China. The inclusion criteria for participants were as follows: (1) currently enrolled and attending classes as usual; (2) voluntary agreement to participate in the study; and (3) no history of psychiatric disorders. Students with

obesity due to specific medical causes (eg, medication side effects) were excluded. All participants provided informed consent and were assured that their responses would remain strictly confidential. The study protocol was approved by the Ethics Committee of Sir Run Run Hospital affiliated with Nanjing Medical University (grant number: 2023-SR-052).

Data were collected face-to-face from participants in a quiet environment. Trained research staff supervised the entire process, which included questionnaire distribution, explanation of the study objectives, and provision of standardized instructions. Participants completed the questionnaires independently after receiving detailed explanations. Demographic information was collected, including age, gender, height, weight, grade level, family monthly income, chronic disease history, weight loss status, etc. Additionally, scales assessing TPs, self-control, and SSB consumption were administered. Upon completion of the survey, the researchers collected and systematically managed the questionnaire data. A total of 1,012 questionnaires were collected. After excluding data with missing values exceeding 25% and random responses, 920 valid questionnaires remained, yielding an effective response rate of 91%.

## Measures

### Time Perspective

Time perspective was assessed using the validated Chinese version of the Zimbardo Time Perspective Inventory (ZTPI),<sup>50</sup> which has been applied in studies involving Chinese participants.<sup>51</sup> The inventory comprises 15 items to assess present-hedonistic TP, 9 items to assess present-fatalistic TP, and 13 items to assess future TP. Items were rated on a 5-point Likert scale (1 = “very uncharacteristic” 5 = “very characteristic”). In this research, Cronbach’s  $\alpha$  for the three dimensions was between 0.70 and 0.77. Each subscale’s overall score is determined by calculating the average of the responses to the corresponding items. A higher score reflects a stronger tendency toward the corresponding TP.

### Self-Control

The Chinese version of the Brief Self-Control Scale (BSCS) was employed to assess participants’ self-control abilities.<sup>52</sup> This scale has demonstrated good reliability and validity and has been used in studies with Chinese populations.<sup>53</sup> It includes two dimensions: self-discipline and impulse control, with a total of seven items. Three items measure self-discipline, while four items assess impulse control. Participants rated each item on a 5-point Likert scale, ranging from “strongly disagree” to “strongly agree.” Higher scores reflect stronger self-control abilities. In this study, the Cronbach’s  $\alpha$  coefficient for the scale was 0.83.

### SSB Consumption

The validated Beverage Intake Questionnaire (BEVQ-15) was employed to assess participants’ frequency and quantity of SSB consumption during the past week.<sup>54</sup> The questionnaire has been utilized to assess beverage intake in Chinese populations.<sup>55</sup> We refined the questionnaire to better reflect the consumption patterns of Chinese university students, including well-known beverage brands within this population to improve clarity in understanding the described drink categories. The questionnaire contains six beverage categories: sugar-sweetened fruit juice, carbonated beverages, sweetened tea, sweetened coffee, energy and sports drinks, and sweetened milk. The participants were instructed to indicate how often they consumed SSBs. (ranging from “less than once a week” or “more than once a week” to “three or more times per day”) and the quantity consumed (from “8 fluid ounces” to “over 20 fluid ounces”). To compute the total consumption, the frequency (ie, “consumption interval”) was converted into daily equivalents, which were then multiplied by the reported quantity for each instance. In this study, the results showed a Cronbach’s alpha coefficient of 0.70, demonstrating satisfactory internal consistency.

### BMI

BMI was calculated based on participants’ self-reported height (in centimeters) and weight (in kilograms), a method considered reliable in studies involving the general population.<sup>56–59</sup> According to the WHO classification standards, individuals with a BMI of less than 18.5 kg/m<sup>2</sup> are categorized as underweight. Individuals with a BMI from 18.5 to 24.9 kg/m<sup>2</sup> are considered to have normal weight. A BMI between 25.0 and 29.9 kg/m<sup>2</sup> is classified as overweight, whereas a BMI of 30.0 kg/m<sup>2</sup> or higher is categorized as obese.<sup>7</sup>

## Data Analysis

Statistical analysis was conducted using SPSS 26. Initially, the data were checked for normality, missing values, and outliers. Variables with non-normal distributions, such as BEVQ, were ln-transformed. The proportions of missing data for the self-control and TP scales were both below 0.13%. Since mean imputation is generally considered acceptable when missing data are under 5%,<sup>60</sup> missing values in these scales were replaced with the mean value of the corresponding items from other participants. No imputation was performed for height, weight, or SSB consumption data, as complete data were available for these variables.

The relationships between the variables were assessed using Pearson correlation coefficients. Subsequently, multiple hierarchical regression analysis was conducted to examine the unique variance in BMI explained by the study variables and demographic factors. In the first step, demographic variables (age, gender, grade level, family monthly income, chronic disease history, and weight-loss status) were entered as predictors. In the second step, TPs, self-control, and SSB consumption were added as predictors, with BMI as the outcome variable. The regression results showed that gender, chronic disease history, and weight-loss status significantly influenced BMI. These factors were incorporated as covariates in the following mediation analysis. Tolerance values for all predictors exceeded 0.6, and variance inflation factors (VIFs) were below 1.5, confirming the absence of multicollinearity.

Mediation analyses were performed using the PROCESS macro (Model 6) to test whether self-control (M1) and SSB consumption (M2) mediated the relationship between TP (X) and BMI (Y). Three chain mediation models were tested, corresponding to the future TP, present-hedonistic TP, and present-fatalistic TP. These models allowed for the examination of multiple indirect pathways. The first pathway tested the indirect effect of TP on BMI through self-control (M1). The second pathway assessed the indirect effect of TP on BMI through SSB consumption (M2). The third pathway explored the serial mediation effect of TP on BMI through both self-control (M1) and SSB consumption (M2). The bias-corrected bootstrap method (5000 resamples) was used to evaluate the mediation effects, with 95% confidence intervals (CI). Statistical significance was established when the confidence interval excluded zero.

## Results

### Participant Characteristics

The research involved 920 individuals (mean age = 19.45 years, SD = 1.20), demonstrating balanced sex representation (51.2% male, 48.8% female). The majority of participants were freshmen (54.7%), followed by sophomores (27.6%). In terms of family monthly income, most participants reported earnings between 3000–5000 RMB (31.4%) and 5000–10000 RMB (36.0%), while smaller proportions earned either less than 1000 RMB (5.2%) or more than 10000 RMB (1.6%). The vast majority of participants (98.0%) reported no history of chronic illness. On average, participants consumed 8.86 ounces (262 mL) of SSBs per week (SD = 10.72), and the mean BMI was 22.81 (SD = 5.21), indicating a generally healthy BMI status (see [Table 1](#)).

### Correlation Analyses

The results of the correlational analyses revealed that all study variables are significantly correlated (see [Table 2](#)). Specifically, present-hedonistic TP and present-fatalistic TP are positively correlated ( $p < 0.01$ ). In contrast, the future TP is negatively correlated with both present-hedonistic TP and present-fatalistic TP ( $p < 0.01$ ). Self-control is negatively correlated with both present-hedonistic TP and present-fatalistic TP ( $p < 0.01$ ), while it is positively correlated with the future TP ( $p < 0.01$ ). SSB consumption is positively correlated with both present-hedonistic TP and present-fatalistic TP ( $p < 0.01$ ), and negatively correlated with the future TP and self-control ( $p < 0.05$ ). Finally, BMI is positively correlated with present-hedonistic TP and present-fatalistic TP, as well as with SSB consumption, and negatively correlated with both future TP and self-control.

### Path Analysis

#### Serial Mediation Model for Future TP

As shown in [Table 3](#) and [Figure 2](#), all standardized path coefficients in the mediation model were statistically significant. The total effect of future TP on BMI was  $-0.39$  (95% CI =  $[-6.04, -4.50]$ ). The direct effect of future TP on BMI was

**Table 1** Participant Demographics (N=920)

| Variable                                     | M±SD, n (%) |
|--|-------------|
| <b>Age (mean ± SD)</b>                       | 19.45±1.20  |
| <b>Gender</b>                                |             |
| Male   | 471(51.20%) |
| Female                                       | 449(48.80%) |
| <b>Grade</b>                                 |             |
| Freshman                                     | 503(54.70%) |
| Sophomore                                    | 254(27.60%) |
| Junior                                       | 153(16.60%) |
| Senior                                       | 10(1.10%)   |
| <b>Family monthly income</b>                 |             |
| ≤1000  | 48(5.20%)   |
| 1000–3000                                    | 145(15.80%) |
| 3000–5000                                    | 289(31.40%) |
| 50,000–10,000                                | 331(36.00%) |
| ≥10,000                                      | 107(11.60%) |
| <b>Chronic disease history</b>               |             |
| Yes  | 18(2.00%)   |
| No   | 902(98.00%) |
| <b>Weight-loss status</b>                    |             |
| Yes  | 399(43.40%) |
| No   | 521(56.60%) |
| <b>Consumption of SSB (ounce, mean ± SD)</b> | 8.86±10.72  |
| <b>BMI (mean ± SD)</b>                       | 22.81±5.21  |

**Abbreviations:** SSB, sugar-sweetened beverage; BMI, body mass index.

**Table 2** Pearson Correlations Among Variables

| Variables             | M     | SD    | 1       | 2       | 3       | 4       | 5      | 6 |
|-----------------------|-------|-------|---------|---------|---------|---------|--------|---|
| 1. Present-hedonistic | 3.17  | 0.46  | I       |         |         |         |        |   |
| 2. Present-fatalistic | 2.86  | 0.52  | 0.47**  | I       |         |         |        |   |
| 3. Future             | 3.46  | 0.39  | -0.12** | -0.24** | I       |         |        |   |
| 4. Self-control       | 3.22  | 0.67  | -0.25** | -0.25** | 0.40**  | I       |        |   |
| 5. SSB consumption    | 8.86  | 10.72 | 0.22**  | 0.17**  | -0.23** | -0.23** | I      |   |
| 6. BMI                | 22.81 | 5.21  | 0.36**  | 0.21**  | -0.42** | -0.38** | 0.41** | I |

**Note:** \*\*p < 0.01.

**Abbreviations:** SSB, sugar-sweetened beverage; BMI, body mass index.

0.23 (95% CI = [-3.81, -2.24]). Moreover, a significant indirect path from future TP to BMI was observed through self-control ( $\beta = 0.11$ , 95% CI = [-0.14, -0.09]) and SSB consumption ( $\beta = -0.03$ , 95% CI = [-0.05, -0.01]). Furthermore, the relationship between future TP and BMI was significantly mediated by the sequential effects of self-control and SSB consumption ( $\beta = -0.02$ , 95% CI = [-0.04, -0.01]). The mediating roles of self-control and SSB consumption represented 41% of the overall effect.

**Table 3** The Association Between Future TP and BMI, Mediated by Self-Control and SSB Consumption

|                 | Self-Control |          | SSB Consumption |          | BMI          |          |
|-----------------|--------------|----------|-----------------|----------|--------------|----------|
|                 | $\beta$ (SE) | t        | $\beta$ (SE)    | t        | $\beta$ (SE) | t        |
| Future          | 0.46(0.05)   | 15.38*** | -0.12(0.09)     | -3.25*** | -0.23(0.40)  | -7.53*** |
| Self-control    |              |          | -0.20(0.05)     | -5.69*** | -0.25(0.24)  | -8.18*** |
| SSB consumption |              |          |                 |          | 0.26(0.15)   | 9.52***  |
| R <sup>2</sup>  | 0.23         |          | 0.10            |          | 0.37         |          |
| F               | 67.74***     |          | 18.91***        |          | 91.06***     |          |

Note: \*\*\*p < 0.001.

Abbreviations: SSB, sugar-sweetened beverage; BMI, body mass index.

### Serial Mediation Model for Present-Hedonistic TP

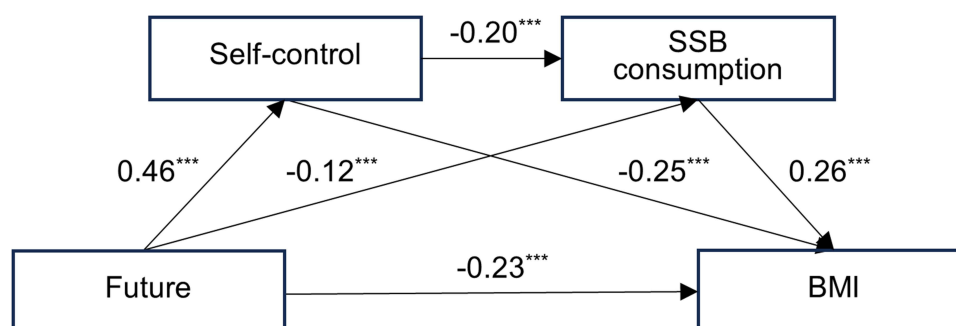
As shown in Table 4 and Figure 3, all standardized path coefficients in the mediation model were statistically significant. The total effect of present-hedonistic TP on BMI was 0.32 (95% CI = [2.94, 4.30]). The direct effect of present-hedonistic TP on BMI was 0.18 (95% CI = [1.47, 2.73]). Meanwhile, a significant indirect path from present-hedonistic TP to BMI was observed through self-control ( $\beta = 0.08$ , 95% CI = [0.06, 0.10]) and SSB consumption ( $\beta = 0.04$ , 95% CI = [0.02, 0.06]). Furthermore, the relationship between present-hedonistic TP and BMI was significantly mediated by the sequential effects of self-control and SSB consumption ( $\beta = 0.02$ , 95% CI = [0.01, 0.02]). The mediating roles of self-control and SSB consumption represented 43% of the overall effect.

### Serial Mediation Model for Present-Fatalistic TP

As shown in Table 5 and Figure 4, the total effect of present-fatalistic TP on BMI was 0.16 (95% CI = [0.97, 2.20]). The direct effect of present-fatalistic TP on BMI was no significant ( $\beta = 0.02$ , 95% CI = [-0.31, 0.80]). However, a significant indirect effect from the present-fatalistic TP to BMI was identified through self-control ( $\beta = 0.09$ , 95% CI = [0.07, 0.12]) and through SSB consumption ( $\beta = 0.03$ , 95% CI = [0.007, 0.05]). Furthermore, the relationship between the present-fatalistic TP and BMI was significantly mediated by the serial indirect effects of self-control and SSB consumption ( $\beta = 0.02$ , 95% CI = [0.01, 0.02]).

## Discussion

This research deepens insights into the connection between TP and BMI. The findings indicated a negative correlation between future TP and BMI, consistent with previous studies and meta-analytic results.<sup>13,22,61</sup> This suggests that individuals with a future-oriented TP generally have healthier BMI levels. Additionally, the study reveals a positive correlation between stronger present-hedonistic TP and higher BMI, supporting existing literature.<sup>21,22</sup> In contrast, the



**Figure 2** Serial mediation model of self-control and SSB consumption between future time perspective and BMI.

Note: \*\*\*p < 0.001.

Abbreviations: SSB, sugar-sweetened beverage; BMI, body mass index.

**Table 4** The Association Between Present-Hedonistic TP and BMI, Mediated by Self-Control and SSB Consumption

|                    | Self-Control |          | SSB Consumption |          | BMI          |           |
|--------------------|--------------|----------|-----------------|----------|--------------|-----------|
|                    | $\beta$ (SE) | t        | $\beta$ (SE)    | t        | $\beta$ (SE) | t         |
| Present-hedonistic | -0.27(0.05)  | -8.36*** | 0.14(0.07)      | 4.34***  | 0.18(0.32)   | 6.56***   |
| Self-control       |              |          | -0.22(0.05)     | -6.63*** | -0.30(0.22)  | -10.64*** |
| SSB consumption    |              |          |                 |          | 0.26(0.15)   | 9.28***   |
| R <sup>2</sup>     | 0.10         |          | 0.10            |          | 0.37         |           |
| F                  | 24.85***     |          | 20.71***        |          | 87.65***     |           |

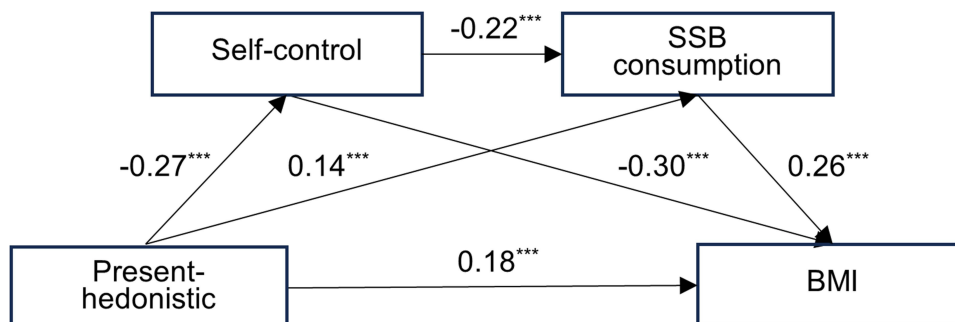
Note: \*\*\*p < 0.001.

Abbreviations: SSB, sugar-sweetened beverage; BMI, body mass index.

direct effect of the present-fatalistic TP on BMI was not statistically significant. However, an indirect mediation effect was observed, contributing a new dimension to the existing literature. The possible explanation is that individuals with a present-fatalistic TP typically perceive the future as being beyond their control, believing that life events are shaped by external forces or fate, and that personal effort cannot alter outcomes.<sup>62</sup> This perception may reduce their motivation to make health-related choices and behave in a more passive manner than those with a present-hedonistic or future TP. This passive model makes the influence of present-fatalistic TP on BMI more indirect, primarily relies on mediating factors like self-control and SSB consumption to exert its effect. To the best of our knowledge, this study is the first to reveal the potential relationship between present-fatalistic TP and BMI.

This study indicated that self-control significantly mediated the relationships between TPs and BMI. Consistent with previous studies,<sup>23</sup> this research indicates that a future TP enhances individual self-control, thereby reducing the risk of higher BMI levels. Conversely, both the present-hedonistic and the present-fatalistic TPs raise this risk. A meta-analysis of the relationship between TPs and outcome variables further substantiates this finding.<sup>63</sup> One potential explanation is that a future-oriented TP motivates individuals to set goals, which subsequently steers them to monitor their progress and take action to realize favorable outcomes. This view is also supported by control theory, which posits that self-regulation commences with goal setting. After setting goals, individuals begin monitoring their behavior and taking necessary actions as needed.<sup>64</sup> In contrast, both the present-hedonistic and present-fatalistic TPs enhance susceptibility to short-term temptations and diminish consideration of future consequences.<sup>19</sup> This undermines the formation of health-related goals, ultimately contributing to the failure of BMI management.

Results of the current study indicated that SSB consumption mediated the relationships between TPs and BMI. This was consistent with previous studies on the effect of TP on health behavior<sup>65</sup> and the SSB consumption on BMI.<sup>34</sup> This mechanism can be understood through delay discounting. Consuming SSBs provides immediate pleasurable rewards, such as taste enjoyment and stress relief,<sup>30</sup> but also leads to long-term health risks, including obesity, diabetes, dental



**Figure 3** Serial mediation model of self-control and SSB consumption between present-hedonistic time perspective and BMI.

Note: \*\*\*p < 0.001.

Abbreviations: SSB= sugar-sweetened beverage; BMI, body mass index.

**Table 5** The Association Between Present-Fatalistic TP and BMI, Mediated by Self-Control and SSB Consumption

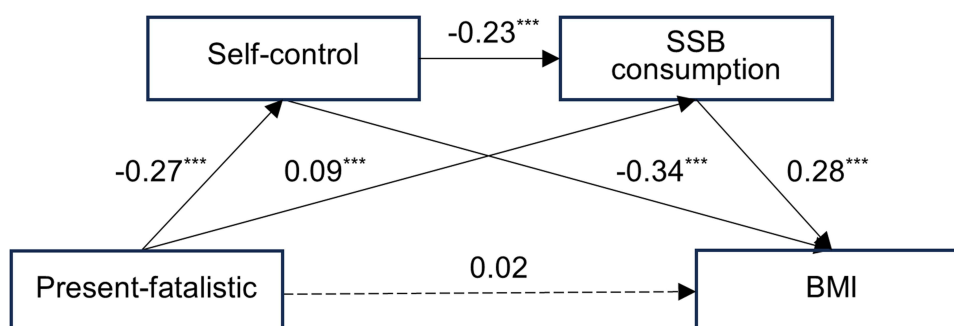
|                    | Self-Control |          | SSB Consumption |          | BMI          |           |
|--------------------|--------------|----------|-----------------|----------|--------------|-----------|
|                    | $\beta$ (SE) | t        | $\beta$ (SE)    | t        | $\beta$ (SE) | t         |
| Present-fatalistic | -0.27(0.04)  | -8.40*** | 0.09(0.06)      | 2.81***  | 0.02(0.28)   | 0.86      |
| Self-control       |              |          | -0.23(0.05)     | -6.99*** | -0.34(0.23)  | -11.62*** |
| SSB consumption    |              |          |                 |          | 0.28(0.15)   | 9.96***   |
| R <sup>2</sup>     | 0.10         |          | 0.09            |          | 0.34         |           |
| F                  | 25.01***     |          | 18.32***        |          | 77.03***     |           |

**Note:** \*\*\* $p < 0.001$ .

**Abbreviations:** SSB, sugar-sweetened beverage; BMI, body mass index.

caries, and other chronic conditions.<sup>34</sup> Individuals with a stronger future TP focus more on long-term consequences and may cognitively heighten the perceived significance of health risks, fostering a negative attitude toward SSBs. According to the Theory of Planned Behavior, attitudes shape behavior through behavioral intentions,<sup>66</sup> with negative attitudes potentially decreasing SSB consumption. Conversely, individuals with a stronger present-hedonistic or present-fatalistic TP are more inclined toward the immediate rewards of SSBs, leading to a more positive evaluation and higher consumption. Research suggests that SSB consumption is positively associated with BMI. Therefore, SSB consumption may act as a crucial mediator in the relationship between TP and BMI. Although this study focused on SSBs, it is important to acknowledge that other ultra-processed foods—such as packaged snacks, processed meats, and ready-to-eat meals—also contribute significantly to obesity development. These foods are typically high in calories, sodium, sugar, and fat,<sup>67</sup> and have pronounced appetite-stimulating effects.<sup>68,69</sup> In recent decades, ultra-processed foods have accounted for a growing share of global dietary patterns, raising concerns about overall diet quality and population-level health outcomes.<sup>70</sup> Therefore, future research could extend the current mediation model to investigate whether TP indirectly affects BMI through the consumption of other ultra-processed foods and similar psychological mechanisms, including self-control.

The mediation analysis suggested that self-control and SSB consumption sequentially mediated the relationships between TPs and BMI. This finding is consistent with previous research on self-control and eating behaviors.<sup>71</sup> This result suggests that individuals with a future TP are more inclined to set long-term health goals, prioritizing them over immediate gratification, which results in stronger self-control. These individuals are more likely to avoid excessive SSB consumption to maintain a normal BMI. In contrast, present-hedonistic and present-fatalistic TP may undermine dietary self-control. Individuals with lower self-control are more prone to making poor dietary choices, such as increased consumption of SSBs.<sup>49</sup> Chronic excessive intake of SSBs contributes to an increase in BMI levels. Although some research has explored the relationship between TP and BMI, this study is the first to establish the mediating role of self-



**Figure 4** Serial mediation model of self-control and SSB consumption between present-fatalistic time perspective and BMI.

**Note:** \*\*\* $p < 0.001$ ; dashed lines indicate a relationship that was not statistically significant.

**Abbreviations:** SSB, sugar-sweetened beverage; BMI, body mass index.

control and specific health behaviors in mediating the relationship between TP and BMI. Future studies could further investigate additional psychological or behavioral mechanisms that might explain the relationship between TP and BMI.

## Implications and Limitations

This study offers both theoretical and practical contributions to understanding the relationship between TP and BMI. Theoretically, it clarifies the direct associations between future and present-hedonistic TPs and BMI, and highlights the serial mediation role of self-control and SSB consumption across all three TPs (future, present-hedonistic, and present-fatalistic). Notably, while the direct effect of present-fatalistic TP on BMI was not significant, this path was mediated by self-control and SSB consumption. These findings help resolve inconsistencies in prior research, which often failed to distinguish between present-hedonistic and present-fatalistic TPs. In practical application, the findings of this study suggest that intervention strategies tailored to an individual's TP could be effective in managing BMI. For example, interventions targeting individuals with a future TP could focus on clarifying goals and promoting self-control through small, manageable steps. In contrast, for individuals with a present-hedonistic TP, interventions using future scenario visualization techniques may help shift focus from immediate rewards to long-term goals. Public health initiatives might also consider offering immediate feedback and rewards, such as points or redeemable prizes, to encourage healthy dietary habits. For individuals with a present-fatalistic TP, interventions should aim to enhance their sense of control over their lives, by helping them recognize the importance of self-control in health-related decisions, thereby motivating them to maintain healthier lifestyle behaviors through self-regulation and dietary management. Moreover, this study found that the surveyed college students consumed an average of approximately 262 mL of SSBs daily. Based on the median sugar content of common SSBs in the Chinese market (8.7 grams per 100 mL),<sup>72</sup> this amounts to an added sugar intake of about 23 grams. The WHO recommends that added sugar intake should not exceed 5% of total daily energy intake.<sup>73</sup> For an adult with a daily energy requirement of 2000 kcal, this corresponds to approximately 25 grams of added sugar. These findings suggest that college students are nearing the recommended upper limit for added sugar intake through SSBs alone, even without considering added sugars from other dietary sources. To address this issue, implementing “nudging” interventions on campus could be an effective strategy. For example, creating a healthier choice environment (eg, reducing the availability and accessibility of SSBs) or providing subtle informational cues (eg, highlighting the health risks of SSBs or promoting positive social norms) could encourage better choices. Given that nudging interventions are efficient, cost-effective, and easy to implement, they hold considerable potential for widespread application in public health initiatives.

Although this study provides new insights into the relationship between TP and BMI, the cross-sectional design employed in this study cannot establish causal relationships between TP, self-control, SSB consumption, and BMI. Future research could adopt a longitudinal design to validate the causal pathways among these variables. Furthermore, the sample was confined to college students in China, limiting the generalizability of the results. Future studies should broaden the sample to improve external validity and generalizability. Moreover, considering the availability and affordability of healthy foods is crucial, as limited access or high costs can restrict dietary choices and increase the risk of unhealthy weight gain. Since purified or mineral water is commonly available and usually free or inexpensive in Chinese universities, this study did not evaluate the availability or affordability of healthy beverages. Nonetheless, future research should thoroughly address this issue when appropriate. Additionally, although BMI is a widely accepted indicator of weight status,<sup>7,74</sup> it may not fully capture actual body fat content, as some individuals within the normal BMI range may still exhibit elevated adiposity. Moreover, pubertal status is also a factor worth considering in relation to BMI, particularly among younger individuals or populations with varied developmental stages. To enhance the accuracy of obesity assessment, future research may consider incorporating more comprehensive physiological indicators. Lastly, this study is the first to examine the full sequential path between TP and BMI by incorporating SSB consumption as a health behavior. Future research could investigate other behavioral mediators to provide a more comprehensive understanding of how TP affects BMI.

## Conclusion

This study examined whether self-control and SSB consumption mediate the relationship between TP and BMI. The results indicated a positive correlation between future TP, present-hedonistic TP, and BMI, while the relationship between present-fatalistic TP and BMI was not significant. Furthermore, self-control and SSB consumption mediated the relationship between future TP, present-hedonistic TP, and present fatalistic TP and BMI. These findings underscore the potential value of interventions tailored to different TPs to promote healthy behaviors and maintain a healthy BMI. Future studies could investigate the impact of additional psychological factors, such as self-efficacy and psychological resilience, or behavioral factors like sleep and physical activity, in the relationship between TP and BMI. This could provide further insight into how TP influences health outcomes.

## Abbreviations

TP, time perspective; BMI, body mass index; SSB, sugar-sweetened beverage.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics Approval and Informed Consent

All procedures were performed in compliance with relevant laws and institutional guidelines, in accordance with the Declaration of Helsinki, and were approved by the Ethics Committee of Sir Run Run Hospital affiliated with Nanjing Medical University (grant number: 2023-SR-052).

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that they have no competing interests in this work.

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