



Consideration of future consequences and self-control mediate the impact of time perspectives on self-rated health and engagement in healthy lifestyles among young adults

Mengxi Guo¹ · Yiling Lou¹ · Ning Zhang¹

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Abstract

The study investigated how different time perspectives predict people's self-rated health and engagement in healthy lifestyles, and explored the mediating effects of consideration of future consequences (CFC) and self-control as the underlying mechanisms. Young adults ($n = 299$, $M_{\text{age}} = 23.65$, ranges from 18 to 30 years old) completed measures of time perspectives, CFC, self-control and engagement in daily health behaviors. Generalized linear regression models showed that Past-Negative time perspective negatively predicted sleep quality; Future time perspective negatively predicted unhealthy eating patterns; Future time perspective was the only protective factor of risky drinking, while both Past-Positive and Future time perspective were protective factors of smoking. Mediation analyses showed that CFC-Immediate and self-control mediated the relationship between Future time perspective and eating patterns. Results suggested that consideration of future consequences and self-control partially explained how time perspectives affect engagement in healthy lifestyles among young Chinese adults. Implications of the current research for promoting healthy living and directions for future research are discussed.

Keywords Time perspectives · Healthy lifestyle · Consideration of future consequences · Self-control · Young adults

Introduction

Behavioral factors, including lifestyles such as tobacco use, unhealthy dietary patterns, physical inactivity and alcohol consumption are well-documented as the most prominent contributors of mortality and morbidity globally (Clifton & Keogh, 2017; Surial et al., 2021; World Health Organization, 2017). Research has consistently demonstrated that healthy lifestyle can improve people's fitness, for instance, proper physical exercise can control weight and reduce the risk of coronary heart disease and diabetes (Chen et al., 2018; Qiu et al., 2018). Healthy lifestyle interventions including diet,

exercise, etc. can change the expression level of prostate tumor related genes and reduce the incidence of diabetes and all-cause mortality (Gong et al., 2019; Ornish et al., 2008). Although many studies have confirmed the effectiveness of lifestyle medicine, the report on nutrition and chronic diseases of Chinese residents (2020) shows that unhealthy lifestyle is still prevalent among the Chinese population. For example, daily cooking oil consumption per household is 43.2 g in China, and more than half of the residents are above the recommended upper limit of 30 g per day; smoking rate of residents aged 15 and above has exceeded a quarter and the problem of children or adolescents drinking sugary drinks too often has also become a pressing public health challenge (The State Council Information Office of the People's Republic of China, 2020). At the same time, overweight and obesity are becoming increasingly prevalent, more than half of Chinese adult residents are overweight or obese. The average weights of Chinese adult male and female are 69.6 kg and 59 kg respectively, with 3.4 kg and 1.7 kg higher than the results released in 2015. Given all these behavioral risk factors, the prevalence of noncommunicable diseases such as hypertension, diabetes, chronic obstructive pulmonary diseases and cancers has also shown

✉ Ning Zhang
zhangning2019@zju.edu.cn

Mengxi Guo
FrosiGuo77@zju.edu.cn

Yiling Lou
lou610@126.com

¹ School of Public Health and the Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou 310058, China

an increasing trend year by year (The State Council Information Office of the People's Republic of China, 2020).

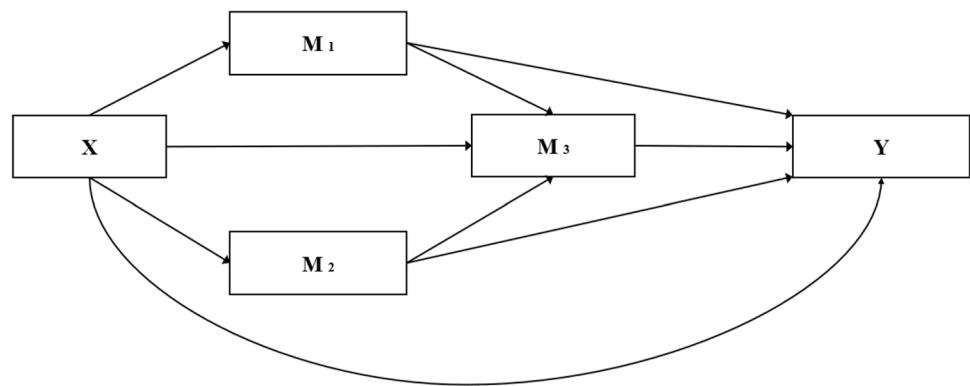
Although many people are aware of the benefits of healthy living, there is still a big gap between people's daily health behaviors and the recommended or ideal healthy lifestyles. Therefore, it's pivotal to understand the predicting factors of healthy lifestyles and its underlying mechanisms to inform the development of scalable interventions to promote healthy living. One possible reason for low engagement in healthy lifestyles is that engagement in healthy lifestyles often involves lots of effort in sacrificing immediate happiness (e.g., eating junk food today) to receive long-term healthy benefits (e.g., maintaining a healthy weight or avoiding chronic diseases). The tradeoffs people need to make for engagement in healthy lifestyles are typical examples of intertemporal choice for health, which refers to the situation that people need to weigh short-term costs and long-term health benefits (Ortendahl & Fries, 2005). A concept associated with intertemporal choice is time perspective, which was first proposed by Lewin (1951) as “the totality of the individual's views of his psychological future and psychological past existing at a given time”. Zimbardo and Boyd (1999) distinguished five temporal dimensions concerning future (i.e., Future-oriented), present (i.e., Present-Fatalistic and Present-Hedonistic) and past (i.e., Past-Negative and Past-Positive). In fact, many studies confirmed that these five temporal dimensions are closely associated to health-related behaviors, such as deciding whether to start or maintain a healthy lifestyle (e.g., engaging in physical exercises, quitting smoking, keeping a balanced diet, etc.) (Daugherty & Brase, 2010) and avoiding addictive disorders (Teuscher & Mitchell, 2011). Specifically, recent studies demonstrated that positive time orientation in the past or higher future time perspective is associated with healthier lifestyles, such as lower BMI (Price et al., 2017), better sleep (Li et al., 2020), and less smoking, drinking, and drug abuse (Akinci & Duman, 2017). But having a short-term or Past-Negative time perspective was associated with more alcohol consumption (Braitman & Henson, 2015), addiction disorders (Chavarria et al., 2015; Miceli et al., 2021), unhealthier food choice (Zhong et al., 2017).

Previous research has demonstrated the importance of time perspective as a vital psychological variable in predicting health-related behaviors, but the underlying psychological mechanism is still unclear. Given the intertemporal nature of many health-related behaviors, another important psychological factor that receives increasing interests between time perspective and health-related choice is an individual's likelihood of considering future consequences in decision making (Strathman et al., 1994). For instance, those score higher on the CFC scale tend to value more about the future consequences of their current behavior and are more likely to engage in physical exercise (Pozolotina

& Olsen, 2021), keep a healthy diet (Dassen et al., 2015) and adopt health-protective behaviors during the COVID-19 pandemic (Zhang & Kou, 2021). Recent research shows that a two-dimensional model of CFC (i.e., CFC-Immediate describes a general preoccupation with immediate outcomes; CFC-Future illustrates a preoccupation with future outcomes of one's actions) could explain specific health behaviors more accurately (Pozolotina & Olsen, 2021). And it has been found that CFC and Zimbardo's time perspective inventory share moderate to strong correlations with each other (Daugherty & Brase, 2010). Moreover, a growing body of studies indicate that individual differences in CFC predict a range of behaviors reflective of self-control (Joireman et al., 2006), which suggests that CFC is likely to have an impact on self-control, a more proximal factor affecting health-related behaviors. For instance, high CFC is positively correlated with personality traits related to self-control, including conscientiousness and delay of gratification, as well as long-term thinking and future-oriented behaviors, and higher self-control has always been correlated with less binge eating and risky drinking, and better mental health (Tangney et al., 2004). There is also evidence that CFC-F is positively correlated with self-control whereas CFC-I is negatively correlated with self-control (Joireman et al., 2008).

For their correlation with time perspective and health-related behaviors, both CFC and self-control are likely candidates to explain the underlying psychological mechanisms accounting for the impacts of time perspective on health behaviors, and self-control may be a more proximal factor affecting behavior. Although previous research has confirmed that self-control mediates the relationship between time perspective and BMI (Price et al., 2017), but it does not consider the role of CFC, nor does it test whether the psychological mechanism can be extended to other domains of healthy lifestyles. On the basis of a full review of previous studies, we hypothesize that individual differences in time perspective reflect variation in people's value of the long-term consequences of their current behavior, directly or indirectly impact their level of self-control, and in turn, predict their engagement in healthy lifestyles in daily lives. Our hypotheses for the current research is as following: H1: Time perspectives predict people's engagement in healthy lifestyles (physical activity, risky drinking, cigarette smoking, eating patterns and sleep quality); H2: CFC and self-control mediate the relationship between time perspective and engagement in healthy lifestyles. The theoretical framework for the current research is displayed in Fig. 1: time perspective (X) influence people's likelihood of consideration future consequences in decision making (M1 and M2), which in turn, impacts their level of self-control in everyday life (M3) and have far-reaching effects on their engagement in healthy lifestyles (Y).

Fig. 1 Parallel multiple mediation model



Methods

Participants

We designed the study and distributed it through an online survey platform (www.wjx.com) on social media. Young adults over 18 years old were recruited through WeChat groups, WeChat circles of friends and online discussion forum of a large public university in Eastern China. A total of 396 young adults participated in the study, with 97 excluded according to priori exclusion criteria set up before data analyses: 1) respondents from the same IP address; 2) filling time of less than 5 min or more than 60 min; 3) logically inconsistent answers to the survey questions. Therefore, a sample of 299 adults aged from 18 to 30 years old ($M_{\text{age}} = 23.65$; Male 41.8%; Female 58.2%) were included in the final analyses, including 118 undergraduates, 125 post-graduates and 56 non-students. All participants provided informed consent upon completing the online questionnaires.

Measures

Demographic Variables

The online survey collected respondents' demographic information including gender, age, student identity and ethnicity. And we also collected data of respondent's height and weight to calculate their body mass index (BMI).

Zimbardo Time Perspective Inventory

The Chinese version of Zimbardo time perspective inventory was used to measure individual differences in time perspectives among respondents (Zimbardo & Boyd, 1999). The inventory includes 56 items and is scored on a 5-point Likert type scale (1 = *very uncharacteristic*, 2 = *uncharacteristic*, 3 = *neutral*, 4 = *characteristic*, 5 = *very characteristic*). The scale consists of 5 dimensions of time perspective (Past-Negative 10 items, Cronbach's $\alpha = 0.748$; Present-Hedonistic 15 items, Cronbach's $\alpha = 0.774$; Future 13 items, Cronbach's

$\alpha = 0.623$; Past-Positive 9 items, Cronbach's $\alpha = 0.662$; Present-Fatalistic 9 items, Cronbach's $\alpha = 0.693$). The items of each dimension were averaged as an index of the corresponding time perspective, and higher score indicates a higher tendency in a particular time perspective. For example, a relative high score in the Present-Hedonistic indicates a stronger tendency to pursue current enjoyment or desired goals.

Consideration of Future Consequences-14 Scale

The CFC-14 scale was used to measure participants' likelihood of considering future consequences of their current behaviors in decision making (Joireman et al., 2012). The scale includes two subscales about concern with future or immediate consequences, such as "I consider how things might be in the future, and try to influence those things with my day-to-day behavior" (CFC-Future 7 items, Cronbach's $\alpha = 0.823$) and "I only act to satisfy immediate concerns, figuring the future will take care of itself" (CFC-Immediate 7 items, Cronbach's $\alpha = 0.807$). Respondents indicated the extent to which each statement is characteristic of themselves on a scale of 1 (*Not at all like you*) to 7 (*Very much like you*). Their responses to these two subscales were averaged into two indexes of CFC-I and CFC-F as two factors of CFC.

Self-Scoring Self-Control Scale

The 10-item SCS, adapted from 36-item Self-Control Scale (Tangney et al., 2004), is scored in the form of a 5-point Likert scale with participants responding to 10 statements from "1 = *Not at all like me*" to "5 = *Very much like me*" (Cronbach's $\alpha = 0.814$). The scale includes 7 reverse statements like "I get distracted easily" and 3 positive statements like "I'm good at resisting temptation", mainly assessing the ability of individuals to control their thoughts, emotions and behaviors in order to overcome unexpected reactions. Participants' responses were averaged and a higher score indicates stronger self-control ability.

Self-Rated Health and Engagement in Healthy Lifestyle

The CDC HRQOL-4 (Moriarty et al., 2003) was used to evaluate participants' current health status, including one self-rated general health measure ("Would you say that in general your health is; Excellent, Very good, Good, Fair or Poor?") and three health-related quality of life measures (recent physical health, recent mental health and recent activity limitation). Participants' answer to the first question was used as an indicator of respondents' overall self-rated health status and used for subsequent analyses. Besides, our study evaluated participants' engagement in healthy lifestyle with 25 items, including physical activity, risky drinking, cigarette smoking, eating patterns and sleep quality. The items of physical activity, risky drinking, cigarette smoking and eating patterns mainly refer to a set of practical instruments recommended by Glasgow et al. (2005) for measuring behavior change in primary care settings, including the Rapid Assessment Physical Activity Scale (RAPA) (Topolski et al., 2006), Starting the Conversation-Diet (STC) (Paxton et al., 2011) and so on. The RAPA involves 9 yes/no items assessing the intensity and frequency of physical exercise in which adults engage in (the last two items on strength training and flexibility were excluded from statistical analysis because they were out of our focus). The summary score of 8-item STC ranged from 0 to 16, with lower score reflecting a healthier diet.

Three items from the Behavioral Risk Factor Surveillance System (BRFSS) (U. S. Department of Health and Human Services, 2004) were used to assess excessive drinking (heavy drinking: more than 2 drinks per day on average for men or more than 1 drink per day on average for women; binge drinking: 5 or more drinks during a single occasion for men or 4 or more drinks during a single occasion for women). Three items from national health surveys (U. S. Department of Health and Human Services, 2004) were used to assess whether respondents ever smoked, their current smoking status and extent of smoking. And current smokers were defined as respondents who smoked 100 cigarettes and now smoked every day or some days, and therefore non-smokers were those who did not currently smoke. Two items from Pittsburgh sleep quality index (PSQI) (Buysse et al., 1989) were used to evaluate sleep quality including time to fall asleep and hours of sleep per night, with a range of 0 to 3 each question and a total score of 0 to 6, and higher score indicated poorer sleep quality.

Analytic Approach

Data analyses were completed with SPSS 26.0 with normality assessed through visual inspection of graphs/plots. The categorical variables were described by frequency and rate, and continuous variables are described by extremum,

mean and standard deviation. Spearman's correlation analysis between time perspective and health-related variables determined further mediation analysis (if $p < 0.05$, the corresponding time perspective variables were included in the preliminary regression model to further screen significant predictors of health behavior). For binary variables like risky drinking and cigarette smoking, a one-way ANOVA compared the scores of each dimension of time perspective between the two groups. Generalized linear regression models were used to indicate the significant predictors of health-related variables. Mediation analyses using Hayes' (2013) PROCESS macro (v. 3.3) were conducted to explore the specific mediating role of CFC and self-control, and covariates were chosen based on the results of regression results.

Results

Descriptive Statistics

The results on all measures are presented (data of recent physical health, mental health and activity limitation are shown in Table 5 in supplementary materials). As shown in Table 1, the gender proportion of respondents was balanced, mainly students under 30 years old. Spearman's rank correlation evaluated the correlation between the 5 dimensions of time perspective and self-rated health status, physical activity, eating patterns and sleep quality (Table 6 in supplementary materials). And one-way ANOVA compared the Zimbardo time perspective scores for the risky drinking group and no risky drinking group, and for the smoking group and no smoking group (Table 7 in supplementary materials).

Regression Analyses

After screening, self-rated health and physical activity were excluded from regression analysis. One-Sample Kolmogorov–Smirnov Test found that data distribution of eating patterns and sleep quality was not normal but conform to Poisson distribution, so generalized linear models were used to identify their predictors (Table 2). Future-oriented time perspective significantly predicted eating patterns ($\beta = -0.164$, 95% CI [-0.277, -0.051], $p = 0.005$), indicating that those scored higher on the future-oriented time perspective were more likely to keep healthy eating patterns. Past-Negative was a strong predictor of sleep quality ($\beta = 0.213$, 95% CI [0.032, 0.384], $p = 0.021$), indicating that those scored lower on Past-Negative time perspective were more likely to have a better sleep. The logistic regression results of risky drinking and smoking were indicated in Table 3. Future-oriented time perspective was the only

Table 1 Descriptive statistics for all variables (N = 299)

Items	Range/Frequency (%)	Mean ± SD
Gender		
Male	125(41.8)	
Female	174(58.2)	
Age (years old)	18—30	23.65 ± 2.17
Student Identity		
Undergraduate	118(39.5)	
Postgraduate	125(41.8)	
Non-student	56(18.7)	
Ethnicity		
Han	284(95.0)	
Other	15(5.0)	
BMI		21.06 ± 2.92
< 18.5	57(19.1)	
18.5 ≤ BMI < 24	198(66.2)	
≥ 24	44(14.7)	
Time Perspective		
Past-Negative	1.50—4.40	3.19 ± 0.52
Present-Hedonistic	1.40—4.80	3.22 ± 0.46
Future	2.38—4.85	3.46 ± 0.38
Past-Positive	1.67—4.67	2.94 ± 0.50
Present-Fatalistic	1.56—4.67	2.95 ± 0.50
Consideration of Future Consequences		
CFC-I	1.57—6.43	4.10 ± 0.88
CFC-F	1.57—7.00	4.76 ± 0.85
Self-Control	1.20—5.00	3.17 ± 0.70
Healthy Lifestyle Engagement		
Physical activity	0.00—7.00	3.63 ± 1.95
Eating patterns	0.00—14.00	6.89 ± 2.14
Sleep quality	0.00—6.00	1.46 ± 1.23
Smoking		
Yes	9(3.0)	
No	290(97.0)	
Risky drinking		
Yes	6(2.0)	
No	293(98.0)	
Self-rated Health		
Excellent	26(8.7)	
Very good	68(22.7)	
Good	92(30.8)	
Fair	106(35.5)	
Poor	7(2.3)	

Percentages in parentheses

protective factor of both risky drinking (OR = 0.096, $p = 0.028$) and smoking (OR = 0.069, $p = 0.006$), indicating that those scored higher on the future-oriented time perspective were less likely to engage in risky drinking and smoking. While Past-Positive could also negatively predict the engagement of smoking (OR = 0.095, $p = 0.001$).

Mediation Analyses

Two mediation models separately examined the indirect effect of Past-Negative time perspective on sleep quality, future-oriented time perspective on eating patterns, with self-control and consideration of future consequences as the mediators. As shown in Fig. 2 and Table 4, future-oriented

Table 2 Generalized linear models of Poisson (N = 299)

Items	β	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	<i>p</i>
Y Eating Patterns ^a							
(Intercept)	2.495	0.1995	2.104	2.886	156.467	1	0.000**
Future	-0.164	0.0577	-0.277	-0.051	8.065	1	0.005**
Y Sleep Quality ^b							
(Intercept)	-0.309	0.3035	-0.904	0.286	1.036	1	0.309
Past-Negative	0.213	0.0922	0.032	0.384	5.336	1	0.021*

^a AIC = 1321.390, BIC = 1328.791;

^b AIC = 915.844, BIC = 923.245

time perspective negatively predicted CFC-I and positively predicted CFC-F and self-control ($\beta = -0.29$, $p < 0.01$; $\beta = 0.55$, $p < 0.01$; $\beta = 0.39$, $p < 0.01$). Stepwise regression model displayed a significant complete mediating effect between future-oriented time perspective and eating patterns through three different paths (Ind2 $X_1 \rightarrow M_2 \rightarrow Y_1$; Ind3 $X_1 \rightarrow M_3 \rightarrow Y_1$; Ind4 $X_1 \rightarrow M_1 \rightarrow M_3 \rightarrow Y_1$, Fig. 2), but only paths of Ind3 (effect size = -0.3666, 95% CI [-0.7178, -0.0657], Table 4) and Ind4 (effect size = -0.0793, 95% CI [-0.1769, -0.0130], Table 4) remained significant by Bootstrap method. Besides, the total effect of Past-Negative on sleep quality was significant, which meant higher Past-Negative score was associated with poorer sleep quality. But the parallel mediating effect of CFC-I, CFC-F and self-control as presented in the Fig. 3 did not hold, Bootstrap showed the same results (Table 4), indicating that these three factors could not explain the impact of Past-Negative time perspective on sleep.

Discussion

To our best knowledge, the study is the first to take both CFC and self-control into account to explain the impacts of time perspectives on engagement in healthy lifestyles. As predicted, future-oriented time perspective was associated with higher engagement in healthy lifestyle (e.g., healthier eating patterns) and less engagement in unhealthy habits including risky drinking and smoking. Past-Positive time perspective was also connected with lower engagement in smoking. By contrast, higher Past-Negative time perspective predicted poorer sleep quality. Overall, consistent patterns of time perspective and engagement in health behaviors were observed in the current study: people who are future-oriented or hold positive attitudes towards past experiences are more likely to engage in health promoting behaviors (e.g., healthier eating patterns) and less likely to engage in health damaging behaviors (e.g., smoking) than those who are present-oriented or hold negative views towards past

experiences. These results contribute to our understanding of the impacts of time perspectives on people's engagement in a range of lifestyle factors, including self-rated health status, eating patterns, physical activity, sleep quality, risky drinking and smoking, which is rare in previous studies on time perspective and health behavior (Braitman & Henson, 2015; Li et al., 2020; Stahl & Patrick, 2012).

In the parallel multiple mediation model of eating patterns, people who held future-oriented time perspective were more likely to consider long-term impact of their behavior and thus displayed healthier eating habits. The other two paths also showed that high future-oriented individuals tended to have high self-control ability, and were less likely to consider immediate impacts of their behavior. Higher self-control directly predicted healthier eating habits; less consideration toward present outcomes of behavior influences eating patterns through enhancing people's self-control ability. The mediating effect of self-control between time perspective and health-related variables was also confirmed by other researchers (Price et al., 2017). However, the significance and robustness of the path through CFC-Future (Ind2) were not supported by Bootstrap method, which needs further studies to verify. The only significant predictor of sleep quality in our study was Past-negative time perspective, but there was no significant mediating effects of consideration of future consequences and self-control. We demonstrated that Past-Negative time perspective was associated with lower sleep quality, but the underlying mechanism was still not clear.

In summary, the results of current study demonstrated the effects of time perspective on people's healthy lifestyle engagement and their underlying mechanisms, which enriched our understanding on how individual differences in time-perspectives influence people's engagement in health-promoting or damaging behaviors and provided multiple intervention points for developing effective behavior change interventions to promote healthy living. For example, to improve adults' diet patterns, intervention designers could clearly inform them of the association between healthy food

Table 3 Logistic regression of risky drinking and smoking (N=299)

Items	Risky drinker/ Smoker n(%)	SOR(95% CI)	<i>p</i>	MOR(95% CI)	<i>p</i>
Y Risky Drinking					
Gender					
Male	4(3.2)	—	—		
Female	2(1.1)	0.352(0.063,1.951)	0.232		
Age (years old)	—	0.822(0.547,1.237)	0.348		
Student Identity					
Undergraduate	2(1.7)	—	—		
Postgraduate	1(0.8)	0.468(0.042,5.227)	0.537		
Non-student	3(5.4)	3.283(0.533,20.231)	0.200		
BMI					
< 18.5	1(1.8)	—	—		
18.5 ≤ BMI < 24	3(1.5)	0.862(0.088,8.445)	0.898		
≥ 24	2(4.5)	2.667(0.234,30.399)	0.430		
Past-Negative	—	0.555(0.120,2.559)	0.450		
Present-Hedonistic	—	4.169(0.727,23.918)	0.109		
Future	—	0.096(0.012,0.780)	0.028*	0.096(0.012,0.780)	0.028*
Past-Positive	—	0.426(0.097,1.868)	0.258		
Present-Fatalistic	—	1.954(0.418,9.138)	0.395		
Y Smoking					
Gender					
Male	6(4.8)	—	—		
Female	3(1.7)	0.348(0.085,1.419)	0.141		
Age (years old)	—	1.028(0.760,1.390)	0.860		
Student Identity					
Undergraduate	4(3.4)	—	—		
Postgraduate	3(2.4)	0.701(0.153,3.200)	0.646		
Non-student	2(3.6)	1.056(0.188,5.942)	0.951		
BMI					
< 18.5	1(1.8)	—	—		
18.5 ≤ BMI < 24	5(2.5)	1.451(0.166,12.675)	0.737		
≥ 24	3(6.8)	4.098(0.411,40.819)	0.229		
Past-Negative	—	2.342(0.620,8.839)	0.209		
Present-Hedonistic	—	1.310(0.305,5.627)	0.717		
Future	—	0.089(0.015,0.510)	0.007*	0.069(0.010,0.472)	0.006**
Past-Positive	—	0.147(0.046,0.468)	0.001*	0.095(0.023,0.392)	0.001**
Present-Fatalistic	—	0.495(0.120,2.039)	0.330		

* *p* < 0.05, ** *p* < 0.01

Fig. 2 Parallel multiple mediation model of eating patterns. Figure shows standardized regression coefficients. **p* < 0.05; ** *p* < 0.01

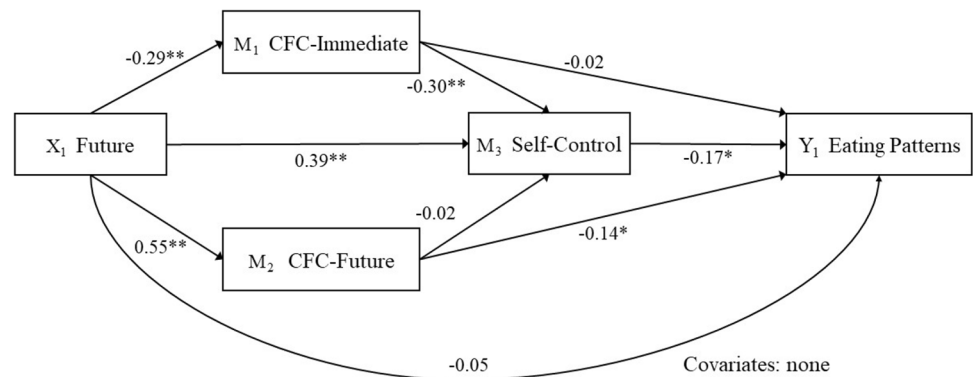


Table 4 Indirect effect of time perspectives on health-related variables

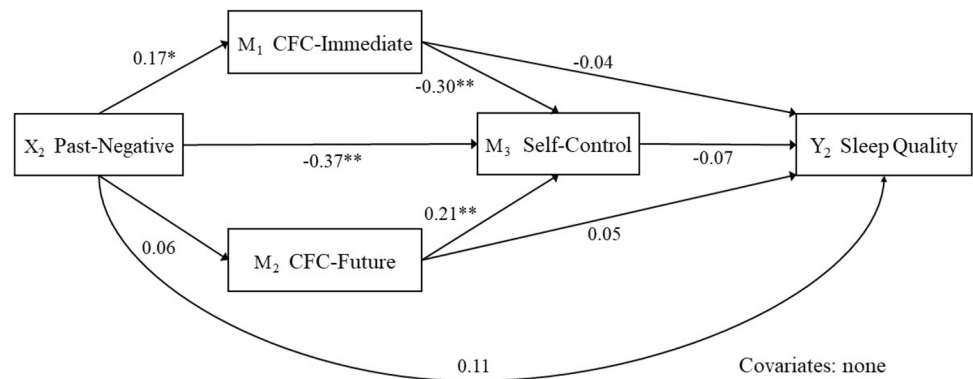
Paths	Effect	BootSE	<i>t</i>	<i>p</i>	Bootstrapping Bias-Corrected 95% CI
Total effect (X₁ → Y₁)	-1.1315	0.3186	-3.5518	0.0004 **	(-1.7584, -0.5045)
Direct effect	-0.3034	0.4147	-0.7317	0.4649	(-1.1196, 0.5127)
Indirect effect(s)					
Total	-0.8281	0.3149			(-1.4417, -0.2087)
Ind1 (X ₁ → M ₁ → Y ₁)	0.0268	0.1016			(-0.1594, 0.2439)
Ind2 (X ₁ → M ₂ → Y ₁)	-0.4208	0.2452			(-0.9075, 0.0520)
Ind3 (X ₁ → M ₃ → Y ₁)	-0.3666	0.1653			(-0.7178, -0.0657)
Ind4 (X ₁ → M ₁ → M ₃ → Y ₁)	-0.0793	0.0420			(-0.1769, -0.0130)
Ind5 (X ₁ → M ₂ → M ₃ → Y ₁)	0.0118	0.0378			(-0.0595, 0.0963)
Total effect (X₂ → Y₂)	0.3081	0.1345	2.2914	0.0226*	(0.0435, 0.5727)
Direct effect	0.2465	0.15	1.6426	0.1015	(-0.0488, 0.5417)
Indirect effect(s)					
Total	0.0617	0.0627			(-0.062, 0.1877)
Ind6 (X ₂ → M ₁ → Y ₂)	-0.0141	0.0259			(-0.0715, 0.0336)
Ind7 (X ₂ → M ₂ → Y ₂)	0.0074	0.0122			(-0.0141, 0.0369)
Ind8 (X ₂ → M ₃ → Y ₂)	0.062	0.06			(-0.0579, 0.1838)
Ind9 (X ₂ → M ₁ → M ₃ → Y ₂)	0.0086	0.0096			(-0.0082, 0.0312)
Ind10 (X ₂ → M ₂ → M ₃ → Y ₂)	-0.0022	0.0036			(-0.0112, 0.0033)

p* < 0.05; *p* < 0.01

Confidence intervals (CI) not including zero demonstrate a statistically significant effect

X₁: Future; Y₁: Eating Patterns; X₂: Past-Negative; Y₂: Sleep Quality; M₁: CFC-I; M₂: CFC-F; M₃: Self-Control

Fig. 3 Parallel multiple mediation model of sleep quality. Figure shows standardized regression coefficients. **p* < 0.05; ***p* < 0.01



choices and future health benefits through specific text or imagery reminders. The effectiveness of this kind of time perspective-based intervention has been verified in fields like retirement planning and prevention of sexually transmitted diseases (Earl & Burbury, 2019; Patterson et al., 2019). Moreover, strategies aimed at enhancing self-control by setting detailed goal of balanced diet or self-monitoring might be useful as well (Hennessy et al., 2020). Comprehensive intervention programs including multi-faceted components with future-oriented time perspective, consideration of future consequences and self-control on individuals or groups could be more effective to promote healthy lifestyles than interventions targeting at one individual component.

Limitations

This study also has many limitations. Firstly, the sample size might not be large enough to illuminate the relationship between each dimension of time perspective and different aspects of healthy lifestyle, such as future-oriented time perspective and physical activity. Although we did not observe significant correlation between physical activity and any dimension of time perspective, previous research has found that future-oriented time perspective predicted higher level of physical activity (Stahl & Patrick, 2012), and brief time perspective interventions could increase physical

activity (Hall & Fong, 2003). Besides, self-rated health was also found to be positively correlated with future-oriented time perspective and negatively correlated with present-oriented time perspective in another research (Liu et al., 2009), however, there was little difference in sample size between this and our study. We speculated that differences between the two research results might partially result from the fact that our findings rested on a simple 1-item question (“Would you say that in general your health is; Excellent, Very good, Good, Fair or Poor?”) to evaluate self-rated health status. Future research can be extended to a more representative sample and other dedicated scales for self-rated health to further test these hypotheses. Secondly, the measurement of sleep was not standardized and did not include subjective sleep quality, which limited the generalization of the current results. More standardized measurement methods should be considered in the future research. Thirdly, the investigation was cross-sectional, which precluded any causal inference for the relationship between time perspective and engagement in healthy lifestyles. Longitudinal research is needed to dynamically observe the changing trends of individual’s time perspective, their engagement in healthy lifestyles and health status. Fourthly, only a small proportion of participants reported drinking alcohol or smoking, and the data on smoking and risky drinking were coded as binary variables, which restricted the possibility of using mediation analysis by PROCESS macro to understand its underlying mechanisms. Future research using continuous measures of risky drinking and smoking can enrich our understanding on its psychological predictors and underlying mechanisms. Furthermore, we examined each aspect of healthy lifestyle engagement separately, but the Healthy Lifestyle Index (HLI) could examine multiple characteristics including eating patterns, physical activity and so on, which has been widely used as a comprehensive index (Hatime et al., 2021). Further studies can try to introduce HLI into the evaluation of healthy lifestyle engagement. And considering that mental health is also an important part of health status, future researchers should also take it into account when building an extended HLI. Our research team are currently working on developing a HLI for use among the Chinese population.

Apart from specific time perspective dimensions, Zimbardo and Boyd (1999) have introduced the concept of Balanced Time Perspective (BTP), defining it as “the mental ability to switch effectively among time perspectives depending on task features, situational considerations, and personal resources”. Our research focused on associations between a specific time perspective dimension and corresponding engagement in healthy lifestyles, which may not be the most adaptive for a given situation (Stolarski et al., 2020). Zimbardo and Boyd (2008) refined the concept by developing the optimal profile of balanced time perspective, featuring low Present-Fatalistic and Past-Negative,

moderately high Present-Hedonistic and Future, and high Past-Positive scores in the Zimbardo Time Perspective Inventory, which suggested the optimal mix of temporal perspectives, allowing an individual to facilitate efficient switching between different temporal horizons in response to situational demands. The Deviation from the Balanced Time Perspective (DBTP) (Stolarski et al., 2011) could explain up to 40% of the variance of individuals’ subjective well-being (Stolarski et al., 2020). Moreover, balanced time perspective is correlated with more positive mental health (Griffin & Wildbur, 2020) and personality traits regarded as highly adaptive (e.g., low neuroticism, high levels of extraversion and executive control) (Stolarski, 2016; Zajenkowski et al., 2016). From this point of view, balanced time perspective brings a more integrated and holistic perception of time and related personal traits, and might be a more accurate and comprehensive predictor of engagement in healthy lifestyles that cannot be well predicted or explained by a single time perspective. Future research is warranted to further investigate how a balanced time perspective predicts engagement in healthy lifestyles and different health outcomes.

Conclusion

In summary, our study confirmed that time perspective influenced Chinese young adults’ engagement in healthy lifestyles. The results added to the limited literature investigating underlying psychological mechanisms between time perspective and healthy lifestyle engagement by providing the evidence that CFC and self-control mediated the relationship between time perspective and engagement in healthy lifestyles. Given the importance of keeping a healthy lifestyle for improving and maintaining optimal level of health and reducing the morbidity and mortality risk of noncommunicable diseases, longitudinal studies are warranted to replicate our findings and provide further evidence on understanding the impacts of time perspectives on engagement in healthy lifestyles and developing effective interventions for promoting healthy living.

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Author contribution M.X.G analyzed the data, drafted and revised the manuscript; Y.L.L helped with research design, data collection of this project; N.Z supervised the study design and data analyses of this project and provided detailed comments on revising the manuscript. The manuscript is partially based on the undergraduate thesis of Y.L.L supervised by N.Z. The authors declare no conflict of interests for this manuscript. All the authors agree with the submission of this manuscript for publication.

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Declarations

Disclosure statement The authors declare no potential conflict of interests with the organizations that sponsor the research.

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