Current Psychology
https://doi.org/10.1007/s12144-021-02160-1

Relationship between self-efficacy, social rhythm, and mental health among college students: a 3-year longitudinal study

Qiongcui Huang [1] · Xueqian Wang [1,2] · Yongjing Ge [1,3] · Dan Cai [1]

Accepted: 24 July 2021

Abstract

Although many empirical studies have aimed to find variances in positive mental health among different groups and the relationship between mental health and other variables, few studies examined the developmental trend of mental health levels and the cross-lagged relationship between self-efficacy, social rhythm, and mental health. Furthermore, few of them explored the interrelationship between self-efficacy and social rhythm among college students over time. This study thus aimed to clarify the longitudinal cross-lagged relationship between self-efficacy, social rhythm, and positive mental health among college students. A total of 764 students (627 females, mean age 21.03 ± 0.84 years at T1) participated in a 3-year-long study (T1, T2, T3) and were asked to complete the General Self-Efficacy, the Brief Social Rhythm, and the Positive Mental Health Scales. The results indicate that the development of positive mental health among college students showed an upward trend during those 3 years. There was a significant relationship between positive mental health, social rhythm, and self-efficacy. Positive mental health and social rhythm significantly predicted self-efficacy in the following year. Positive mental health in T2 could predict both T3 social rhythm marginally and T3 self-efficacy significantly. However, T1 social rhythm was not indirectly associated with T3 mental health via T2 self-efficacy, and T1 self-efficacy was not indirectly associated with T3 mental health via T2 social rhythm. This finding clarified the relationship between positive mental health, self-efficacy, and social rhythm, and provided evidence that positive mental health is the basis for self-efficacy and social rhythm among young adults. Therefore, school psychologists in universities should pay close attention to the positive mental health of young adults to form high levels of self-efficacy and social rhythm.

Keywords Self-efficacy · Social rhythm · Mental health · College students · Longitudinal study

Introduction

According to the Washington Department of Health and Human Services (2020), mental health involves individuals' emotional, psychological, and social well-being. It affects how one thinks, feels, and acts. It also indicates how one will handle stress, relate to others, and make choices. Mental health is important at every stage of life, from childhood, over adolescence and adulthood, to old age. In recent decades, positive aspects of mental health have played a significant role in public mental health care. Some researchers have proposed that the definition of positive mental health is not only a property of an individual, but is heavily influenced by social phenomena as well (Karlsson, 2012). According to the dual-factor model of mental health, there are three core components of mental health: emotional, positive, and social well-being (Keyes, 2007). Some studies have shown that positive mental health is a predictor of recovery from mental illness, whereas Iasiello et al. (2019) found that it could protect people from affective disorders. Moreover, positive mental health is an important factor in predicting remission from anxiety disorders and depression (Teismann et al., 2018). Mental health is influenced by many factors, including everyday behaviors that can be altered by individuals (Velten et al., 2014). A study suggested that personal well-being, physical health, psychological well-being, and environmental health predict adolescents' positive mental health (Singh & Junnarkar, 2015). In addition, some protective factors such as sufficient sleep and physical activity and a healthy diet were associated with better

Qiongcui Huang and Xueqian Wang contributed equally to this work.

✉ Dan Cai
caidan@shnu.edu.cn

[1] Education College, Shanghai Normal University, No. 100, Guilin Road, Shanghai 200234, China

[2] Collaborative Innovation Center of Assessment toward Basic Education Quality, Beijing Normal University, Beijing, China

[3] The Research Base of Online Education for Shanghai Middle and Primary Schools, Shanghai, China

Published online: 14 August 2021

mental health outcomes (Kaneita et al., 2007; Cairns et al., 2014). Furthermore, a study aimed at investigating the relationship between daily stressors, self-efficacy, and mental health in samples of college students from Germany, Russia, and China, and found that perceived self-efficacy was a mediator between the effects of daily stress and positive mental health (Schönfeld et al., 2016). Based on these studies, we tested the relationship between self-efficacy, social rhythm, and mental health among Chinese college students.

As an important part of social cognitive theory, self-efficacy refers to the degree of confidence individuals show in their ability to act in a particular situation (Skaalvik & Skaalvik, 2017). Based on social cognitive theory, individuals' healthy behavior is not driven by internal forces, nor is it automatically shaped and controlled by external stimuli. Instead, it is a result of the interaction between environmental, behavioral, and personal factors (Bandura, 1977). In other words, when facing the pressures of the surrounding environment, individuals who have internal confidence in controlling, eliminating, or reducing the severity of a threatening event are not defeated by it. Thus, stress response is the result of low self-efficacy in controlling threats or overloaded environmental pressure. Whether an individual adopts healthy behaviors is closely related to the level of self-efficacy.

Previous studies have demonstrated that self-efficacy and mental health are significantly correlated. For instance, individuals with higher self-efficacy are more likely to adopt healthy behaviors, so the positive factors of mental health show a higher level, while the negative factors of mental health show a lower level (Holden, 1991; Sylvia, 2015). Furthermore, a study examined the relationship between self-efficacy and other psychological structures across five countries, suggesting that self-efficacy is positively associated with optimism, self-esteem, and self-regulation (Luszczynska et al., 2005a); that is, people with a high sense of self-efficacy believe they have the ability to solve problems and accomplish their goals, so they are more satisfied with life than those with lower self-efficacy are (Azizli et al., 2015). Moreover, a study that examined young adults suggested that self-efficacy and hope were significantly positively correlated with mental health, and these two predictor variables were able to predict it (Bai et al., 2017). In addition, some studies have suggested that self-efficacy is associated with mental disorders, such as anxiety and depression. People with low self-efficacy are more likely to experience negative emotions and high levels of anxiety, depression, and distress (Karademas & Kalantzi-Azizi, 2004; Lee & Hayes-Skelton, 2018; Schönfeld et al., 2016). Therefore, increasing self-efficacy can reduce some negative attitudes and the effects of stress on health; help to avoid social risks, low self-esteem, and depression; and in turn, promote mental health (Parto, 2011). Although there are some studies on this topic, we found that the mutual relationship between self-efficacy and mental health is unknown.

In the social zeitgeber theory, "social zeitgeber" refers to personal relationships, social demands, or tasks that serve to entrain biological rhythms (Ehlers et al., 1988). There are some external clues that can control biological rhythms, including eating, sleeping, getting up, exercising, going to school or working, entertaining, participating in social activities, and so on, whereas disruption or irregularity in time cues that trigger one's biological and social behavior can lead to increased symptoms of mental illnesses (Gorwood, 2012; Lieverse et al., 2013; Wever, 1979). Therefore, in our study, social rhythm reflects one's life regularity, which includes sleep times, diet, and social contacts. As described above, the level of self-efficacy is correlated with an individual's social rhythm. People with higher self-efficacy are more likely to adopt healthy behaviors and may have a regular social rhythm. Shojaei et al. (2018) suggested that circadian rhythm is one of the factors affecting an increase or decrease in the quality of working life and self-efficacy. Few studies have examined social rhythms and self-efficacy. Bihlmaier and Schlarb (2016) investigated the correlation between self-efficacy and sleep behavior in school-aged children. They found that healthy children with regular sleep behavior had higher self-efficacy than children with sleep problems did. Higher self-efficacy was related to lower sleep problems, such as delayed sleep onset. The same results are available in another study aimed at college students where researchers tested self-efficacy, sleep problems, sleep characteristics, and insomnia. Results showed that self-efficacy and insomnia had a significant association (Schlarb et al., 2012). In other words, students without sleep problems have a higher self-efficacy than those with insomnia.

Social rhythm and behavioral patterns in daily routines are related to mental health; some changes in regular biological daily patterns such as bedtime, social contacts, mealtime, and working schedules lead to mental illnesses (Ehlers et al., 1988; Grandin et al., 2006; Lieverse et al., 2013). Furthermore, another study found that poor sleep quality was associated with difficulties in mental and physical health among college students (Pilcher & Ott, 1998). As the social zeitgeber theory describes, stressful life events can disturb social zeitgeber, and accordingly, a change occurs in the stability of social rhythms. Eventually, this leads to depression, which in turn affects the biological rhythm of the individual (Ehlers et al., 1988). Many studies have proved this theory (Boland et al., 2016; Lieverse et al., 2013). Previous studies have found that social rhythm disruptions may contribute to or increase the symptoms of psychological disorders, such as bipolar disorder and depression. Furthermore, Shen et al. (2008) suggested that individuals with bipolar disorder had lesser social rhythm regularity compared to normal controls, and a low social rhythm regularity predicted affective episodes in

participants with bipolar disorder. Similarly, university students with sleep disorders showed a lower frequency of social interactions than the controls did (Carney et al., 2006).

These studies indicated that social rhythms related to negative mental health and irregular social rhythms may cause mental illness. According to the dual-factor model of mental health, mental illness is associated with mental health, but they are two distinct dimensions (Westerhof & Keyes, 2010). Therefore, both negative and positive aspects of mental health should be emphasized. In fact, limited studies on social rhythm and positive mental health have been conducted. One study showed that social rhythm was significantly associated with life satisfaction, anxiety, and stress, and that regular social rhythms can reflect good mental health. Meanwhile, less social rhythm regularity predicts anxiety and stress (Velten et al., 2018). In addition, some studies have found that sleep quality may predict the positive and negative dimensions of mental health among college students. (Peach et al., 2016).

In terms of the developmental trend of college students' mental health, previous studies drew inconsistent conclusions. A 3-year-long longitudinal study suggested that during college life, students' scores of positive mental health first showed a downward and then an upward trend (Cai et al., 2017). However, another longitudinal study found a different result: students' scores of positive mental health showed a downward trend (Bieda et al., 2019). These contradictory results provided us with some information, but more research should be conducted to explore the current situation and trends regarding college students' mental health. Therefore, a purpose of this study was to investigate trends in the mental health of college students.

Existing research indicates that self-efficacy is closely related to mental health, and individuals with high self-efficacy have better mental health (Azizli et al., 2015; Abdel-Khalek & Lester, 2017); thus, it can be speculated that self-efficacy can affect the development of mental health. In addition, it is essential to evaluate the relationship between social rhythms and the mental health of college students. Previous studies have focused on social rhythm disruptions and mental illness (Boland et al., 2012; Frank et al., 2005; Shen et al., 2008; Sylvia et al., 2009), but only a few have examined the mechanism of the action of social rhythm on positive mental health (Cai et al., 2017; Margraf et al., 2016). Second, when first-year Chinese students enter the university, their curriculum arrangements and lifestyles are quite different from those of middle school students. In particular, they have more freedom to arrange their own lifestyles. Such a great change in life rhythm probably made it difficult for them to perceive control over internal states in their freshmen year, which was confirmed to have a negative effect on individuals' behavior and physical and mental health (Cai et al., 2017; Zhang et al., 2020; Pallant, 2000; Wu et al., 2020). However, based on current studies, it is difficult to determine the developmental trend of college students' social rhythm.

Extensive research has been conducted on the relationship between mental health and other variables (Cai et al., 2017; Duan, 2016; Hu et al., 2020; Lamers et al., 2015). However, it remains unknown whether they reciprocally influence one another or if one causes the other. For this reason, the developmental cascades of mental health, self-efficacy, and social rhythm in college students are yet to be examined. This study thus considered the theoretical perspective of the development cascade model to examine interrelations among mental health, self-efficacy, and social rhythm (Masten & Cicchetti, 2010), which is whether social rhythm could influence mental health by promoting self-efficacy, or whether self-efficacy helps to promote mental health through a high level of social rhythm over time. Based on the above discussion, we hypothesized that (1) the level of mental health of college students would change with grade increase; (2) self-efficacy would positively correlate with mental health and social rhythm at each time point; (3) self-efficacy and social rhythm would predict each other, which in turn would subsequently promote the level of mental health; and (4) mental health would predict both self-efficacy and social rhythm over time.

Method

Participants

The participants were college students from a university in Shanghai, China. All of them were randomly selected from the majors of humanities, education, mathematics and science, and construction engineering. The study lasted 3 years (2014–2016) with one distribution of questionnaires each year (referred to as T1, T2, and T3, respectively). A total of 1622 students took the test in 2014. In 2015, 1277 junior students were selected. In T3, 1055 senior students participated in the study because some students moved to another campus. Furthermore, participants who completed <80% of the three target scales, who were suspected not to respond sincerely, or who missed one or more surveys were excluded. Of these, 764 students participated for 3 years, of which 627 were female and 137 were male. The average age (at T1) of the longitudinal sample was 21.03 ± 0.84 years, ranging from 18 to 24.

Measures

Self-Efficacy The General Self-Efficacy Scale was used to measure self-efficacy. It was created by Ralf Schwarzer, a German clinical and health psychologist (Schwarzer et al., 1999). The original scale of 20 items was reduced to five, which were scored on a 4-point Likert scale (1 = *disagree* to 4 = *strongly agree*). A high score indicated that a person had

higher self-efficacy. Sample items were "It is easy for me to stick to my aims and accomplish my goals," and "I am confident that I could deal efficiently with unexpected events." The Chinese version of the General Self-Efficacy Scale was compiled by Zhang in 1995 and has good reliability and validity (Zhang & Schwarzer, 1995). In this study, the Cronbach's alphas for the 3 years were T1 = 0.89, T2 = 0.91, and T3 = 0.88, respectively.

Social Rhythm The Brief Social Rhythm Scale was used to measure the rhythm of life, and participants' daily activities such as mealtimes, bedtimes, and wake-up times during the school week and on the weekend were investigated (Margraf et al., 2016). Cai et al. (2017) used the Brief Social Rhythm Scale to examine social rhythms in a sample of Chinese college students. This scale consists of 10 items rated on a 6-point Likert scale (1 = *very regular* to 6 = *very irregular*). Sample items were "Going to bed Mondays through Fridays," "Going to bed on the weekend," and "Meeting other people at school or work Mondays through Fridays." Final scores were recoded reversely; therefore, participants with higher scores had a regular life rhythm. The internal consistency for the 3 years was T1 = 0.87, T2 = 0.89, and T3 = 0.88, respectively.

Positive Mental Health Positive Mental Health Scale was used to measure the participants' levels of positive mental health (Margraf et al., 2016). It contained nine items, and participants answered on a 4-point Likert scale (1 = *disagree* to 4 = *strongly agree*). Higher scores indicated higher levels of mental health. There are some items, "All in all, I am satisfied with my life," "I feel that I am actually well equipped to deal with life and its difficulties," and "Much of what I do brings me joy." Wu et al. (2020) applied the translation–backtranslation–revision method to create the Chinese version. The Positive Mental Health Scale exhibited strong cross-cultural measurement invariance across student samples from Germany, Russia, and China (Velten et al., 2018). The internal consistency of this study for the 3 years was T1 = 0.90, T2 = 0.94, and T3 = 0.93.

Data Collection

All participants were asked to complete the questionnaires in the classroom, with a pencil and paper provided by survey conductors, who were two trained graduate students majoring in psychology. The students who agreed to participate in the survey entered the pre-arranged classroom in groups and conducted the questionnaire survey. The General Self-Efficacy Scale, the Brief Social Rhythm Scale, and Positive Mental Health Scale were applied in May each year. Participants took approximately 20 min to complete the questionnaires. After completing the survey, they received a compensation of approximately 5 yuan.

Results

Descriptive Statistics for all Measures

The means and standard deviations are listed in Table 1. The *t*-test was used to compare the differences between men and women in terms of self-efficacy, social rhythm, and positive mental health. The results show that there were no gender differences in self-efficacy and social rhythm scores at each time point. However, a significant difference was found between males and females in terms of positive mental health at all three time points. Specifically, the level of positive mental health was significantly lower in men than in women, and the values were as follows: T1 ($t = 2.18$, $p < 0.05$, *Cohen's d* = 0.22), T2 ($t = 2.04$, $p < 0.05$, *Cohen's d* = 0.20), and T3 ($t = 3.9$, $p < 0.001$, *Cohen's d* = 0.36).

Repeated measure ANOVAs were conducted to test for any differences in participants' self-efficacy, social rhythm, and mental health over time. Significant differences were found in the 3 years of self-efficacy ($F = 25.06$, $p < 0.001$, $\eta^2 = 0.032$). Pairwise comparisons showed that self-efficacy at T1 was significantly lower than that at T3 ($t = -6.31$, $p < 0.001$), and that self-efficacy at T2 was significantly lower than that at T3 ($t = -6.34$, $p < 0.001$).

Table 1 *Mean and standard deviation (SD) descriptions of social rhythm, self-efficacy, and mental health of different genders at each time point*

	T1			T2			T3		
	Male *Mean (SD)*	Female *Mean (SD)*	Overall *Mean (SD)*	Male *Mean (SD)*	Female *Mean (SD)*	Overall *Mean (SD)*	Male *Mean (SD)*	Female *Mean (SD)*	Overall *Mean (SD)*
SE	13.86 (3.00)	14.22 (2.99)	14.16 (2.99)	14.05 (3.27)	14.12 (3.13)	14.11 (3.15)	14.93 (2.56)	14.84 (2.43)	14.85 (2.45)
SR	45.82 (9.81)	46.67 (7.47)	46.50 (7.95)	44.89 (9.86)	45.03 (7.84)	44.99 (8.26)	44.42 (9.29)	45.17 (8.24)	45.06 (8.45)
MH	19.66 (5.17)	20.70 (4.37)	20.52 (4.55)	19.91 (5.75)	20.97 (4.63)	20.76 (4.87)	19.60 (4.97)	21.31 (4.60)	21.01 (4.71)

Note. SE, self-efficacy; *SR,* social rhythm; *MH,* mental health; *T1,* time 1; *T2,* Time 2; *T3,* Time 3

Table 2 Correlations of three variables for participants at each time point

	1	2	3	4	5	6	7	8	9
MH (T1)	–								
MH (T2)	.49***	–							
MH (T3)	.50***	.50***	–						
SE (T1)	.62***	.33***	.34***	–					
SE (T2)	.31***	.50***	.30***	.37***	–				
SE (T3)	.35***	.37***	.57***	.39***	.35***	–			
SR (T1)	.38***	.23***	.27***	.29***	.19***	.26***	–		
SR (T2)	.24***	.37***	.22***	.21***	.30***	.22***	.45***	–	
SR (T3)	.24***	.19***	.31***	.22***	.11***	.27***	.36***	.37***	–

Note. SE, self-efficacy; *SR*, social rhythm; *MH*, mental health; *T1*, Time 1; *T2*, Time 2; *T3*, Time 3; *** $P < 0.001$

There were significant differences in the 3 years of social rhythm ($F = 13.39$, $p < 0.001$, $\eta^2 = 0.017$). Pairwise comparisons showed that the social rhythm at T1 was significantly higher than at T2 ($t = 4.87$, $p < 0.001$) and T3 ($t = 4.27$, $p < 0.001$). There was no significant difference between the social rhythms at T2 and T3.

Furthermore, there were significant differences among the evaluations of 3 years of mental health ($F = 4.19$, $p < 0.05$, $\eta^2 = 0.005$). Pairwise comparisons showed that mental health at T1 was significantly lower than that at T3 ($t = -2.95$, $p < 0.01$). There was no significant difference in mental health between the T2 and T3 groups.

Correlation between Self-Efficacy, Social Rhythm, and Mental Health

Statistical analyses were performed using the SPSS version 22. Table 2 shows the correlations of self-efficacy, social rhythm, and mental health at three time points. Correlation analyses indicated that self-efficacy correlated positively with mental health each year (Pearson's *r*, .50–.62) and across years (Pearson's *r*,.30–.37). In addition, there was a significant positive correlation between social rhythm and mental health at each year (Pearson's *r*, .31–.38) and across years (Pearson's *r*, .19–.27). Self-efficacy was positively correlated with social rhythm at each year (Pearson's *r*, .27–.30) and across years (Pearson's *r*, .11–.26).

Cross-Lagged Panel Modeling

The correlations between self-efficacy, social rhythm, and mental health (Table 2) showed that their scores were significantly correlated at each time point (e.g., SR and MH at T1, $r = 0.38$, $p < 0.001$) and across time points (e.g., for MH at T2 and SE at T3, $r = 0.37$, $p < 0.001$).

Cross-lagged analysis was used to investigate the interaction between self-efficacy, social rhythm, and positive mental health at the three time points (Fig. 1). Because there were no gender differences in the self-efficacy and social rhythm scores at each time point, we used one cross-lagged model in our analysis. The cross-lagged model had a good fitting index, $\chi^2(9) = 159.32$, $p < 0.001$, CFI = 0.928, NFI = 0.926, RMSEA = 0.148 (90% CI [0.128, 0.169]). After controlling for the correlation and stability of self-efficacy, social rhythm, and positive mental health, T1 self-efficacy did not significantly predict positive mental health in T2 ($\beta = 0.04$, $p > 0.05$). Positive mental health in T1 significantly predicted T2 self-efficacy ($\beta = 0.10$, $p < 0.05$). Similarly, after controlling for other T2 variables, T2 self-efficacy did not significantly predict positive mental health in T3 ($\beta = 0.06$, $p > 0.05$). T2 positive mental health significantly predicted T3 self-efficacy ($\beta = 0.23$, $p < 0.001$).

In addition, T1 social rhythm did not significantly predict positive mental health in T2 ($\beta = 0.05$, $p > 0.05$), and positive mental health in T1 did not significantly predict T2 social rhythm ($\beta = 0.05$, $p > 0.05$). Furthermore, T2 social rhythm did not significantly predict positive mental health in T3 ($\beta = 0.03$, $p > 0.05$). Positive mental health in T2 predicted T3 social rhythm; thus, the predictive power reached marginal significance ($\beta = 0.07$, $p = 0.06$).

The results showed that T1 self-efficacy did not significantly predict T2 social rhythms ($\beta = 0.06$, $p > 0.05$). T1 social rhythm predicted T2 self-efficacy, and predictive power approached significance ($\beta = 0.07$, $p = 0.06$). T2 self-efficacy also did not significantly predict T3 social rhythm ($\beta = -0.03$, $p > 0.05$), and T2 social rhythm significantly predicted T3 self-efficacy ($\beta = 0.07$, $p < 0.05$).

However, the results show that there were no development cascade effects in this model. In other words, T1 self-efficacy was not found to have a significant indirect effect on T3 mental health via T2 social rhythm. The indirect effect of T1 social rhythm on T3 mental health via T2 self-efficacy was also not significant.

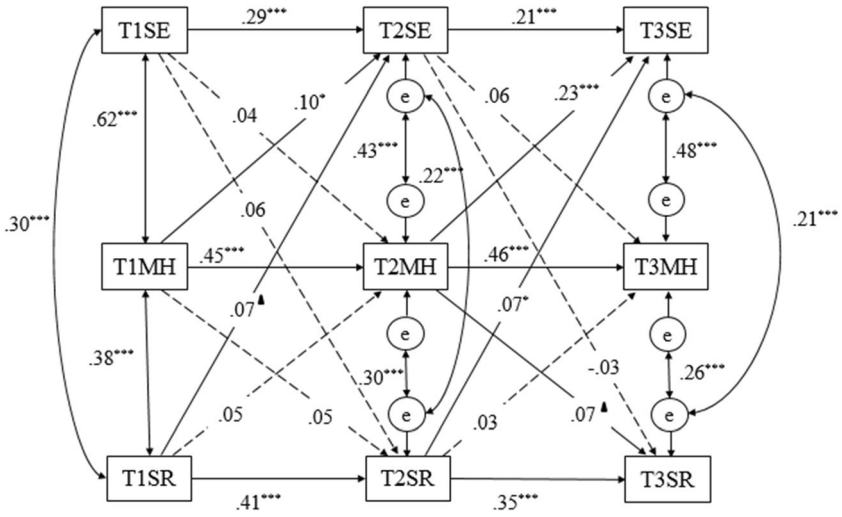

Fig. 1 *Cross-lagged structural model for self-efficacy, social rhythm, and mental health.* Note that the standardized coefficients are displayed in the model. e, measurement error; SE, self-efficacy; SR, social rhythm; MH, mental health; T1, Time 1; T2, Time 2; T3, Time 3; $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, $^{\blacktriangle}p < 0.1$

Discussion

The present study found a significant relationship between self-efficacy, social rhythm, and mental health among college students over the period of 3 years, and the results showed that college students' mental health increased every year, while self-efficacy and social rhythm seemed to have decreased first at T2 and then increased at T3. In addition, our analyses explored the bidirectional relationship between self-efficacy, social rhythm, and mental health. These findings enrich previous longitudinal study results and enhance the understanding of the relationship between self-efficacy, social rhythm, and mental health among college students.

The results showed that mental health among females was higher than among males at each time point, which was consistent with previous studies (Jeyagurunathan et al., 2017; Yue et al., 2017). Females were more likely to express negative emotions with their friends and often reported better social relationships (Ryff & Keyes, 1995). A better social relationship is linked to higher levels of social support, which plays a positive role in improving individuals' mental health (Keyes, 2006; Wang et al., 2018). The results further show that the level of mental health among college students increased every year, which confirms our first hypothesis. One possible explanation is that the college students in our study had just entered a new environment in their freshman year, which was different from that of middle school students. Therefore, they needed time to adapt to their new lifestyles and changes in their surrounding environment. Based on the above reasons, the scores for positive mental health during the first year were relatively low. However, after adjusting to college life and possibly finding their life purpose (Zhang et al., 2019), students' level of positive mental health improved significantly.

As hypothesized, the correlation analysis showed a positive relationship between self-efficacy and mental health, which is consistent with previous studies. The level of mental health can be reflected in college students' sense of self-efficacy. A strong sense of self-efficacy predicted better health outcomes (Bandura, 1977) and enhanced personal well-being (Karademas & Kalantzi-Azizi, 2004). In contrast, low self-efficacy was related to psychological symptoms of anxiety and distress (Bandura, 1977; Schwarzer, 1993; Sandin et al., 2015; Schönfeld et al., 2016). Promoting self-efficacy may improve the mental health of individuals with social anxiety disorder (Lee & Hayes-Skelton, 2018; Goldin et al., 2012). Therefore, self-efficacy was an important factor that affected one's life satisfaction, personal well-being, and positive attitudes (Azizli et al., 2015; Judge et al., 2002; Luszczynska et al., 2005b). Furthermore, we found a positive relationship between social rhythms and mental health. The results also indicated that a person's mental health could be prompted by enhancing social rhythm regularity (Margraf et al., 2016). Social rhythm regularity is a strong predictor of positive mental health, suggesting that improving social rhythms helps to increase psychological well-being among college students (Cai et al., 2017; Julia et al., 2018). In particular, people with a regular rhythm have good sleep quality, which in turn may help to increase the positive aspects of mental health, such as a sense of well-being (Hamilton et al., 2007; Morgan, 2003; Peach et al., 2016). Many studies demonstrated that a stable social rhythm was beneficial in the reduction of mental illness symptoms, for instance, and modifying the biological rhythm would reduce the psychological and physiological symptoms of depression (Salgado-Delgado et al., 2011). There is no doubt that a regular life rhythm provides a more positive mindset and helps to protect people from mental illness. Finally, we found that self-efficacy was positively related to the social rhythm of college students at each time point, indicating that a high level of self-efficacy was more likely related to a regular social rhythm. This result was consistent with a previous study, which suggested that there was a negative correlation between self-efficacy and

sleep problems (Przepiórka et al., 2019). Furthermore, Angelika et al. (2012) regarded self-efficacy as a protective resource for maintaining sleep hygiene, which involves regular sleep schedules. In other words, individuals with high self-efficacy have fewer sleep problems, and their sleep time is more regular than in those with low self-efficacy.

We did not find any developmental cascades of mental health, self-efficacy, and social rhythm from the cross-lagged analyses in this study. Specifically, self-efficacy and social rhythm failed to predict one other, and these two variables failed to promote mental health. This conclusion is contrary to that of H3. One explanation may be that the cross-lagged pathways between self-efficacy, social rhythm, and mental health are completely sophisticated, and no relevant research has drawn a clear conclusion. Another explanation for such results may be that social rhythm mainly focused on the regularity of life during the school week and on the weekend, such as going to bed and meeting friends. Nevertheless, it does not reflect an individual's sleep quality. Furthermore, Velten et al. (2014) concluded that a higher frequency of physical exercise could predict positive mental health. However, the predictive relationship between social rhythms and physical exercise remains unknown. To the best of our knowledge, this study is the first to test the developmental cascade effects of self-efficacy, social rhythm, and mental health. Future research could consider additional variables, such as physical activity and sleep quality. However, there were some longitudinal relationships between these three variables. First, students' mental health could significantly predict self-efficacy in the following year. This means that individuals with a higher level of positive mental health may be more confident in overcoming difficulties. In other words, they have high self-efficacy. Similar results could be found in other studies, which suggested that positive mental health could help people regulate their emotions better and be more capable of facing and accepting problems (Bieda et al., 2019; Yiengprugsawan et al., 2012). In addition, the cross-lagged panel model showed that social rhythm could not predict mental health in the following year, while mental health could predict social rhythm in the following year. A study of the relationship between lifestyle and mental health in adults investigated whether a regular social rhythm could reflect positive mental health (Velten et al., 2018). Studies examining positive mental health have found a greater impact on social rhythms and self-efficacy. Lastly, the results indicate that social rhythm can predict self-efficacy significantly across years. Individuals with regular social rhythms, such as regular sleep, frequent exercise, eating healthy food, and getting sufficient rest may have high self-efficacy, because a regular life allows them to believe that they are capable of dealing with the issues they encounter. This result was consistent with a study aimed at improving children's self-efficacy, which found that lifestyle intervention resulted in a significant improvement in children's sense of self-efficacy (De Villiers et al., 2016).

It is worth pointing out that in comparison to previous studies that used positive mental health solely as an outcome measure index (Bai et al., 2017; Velten et al., 2018), the present study considered positive mental health as a predictive factor and found that positive mental health had a greater impact on social rhythm and self-efficacy; that is, mental health was the basis for self-efficacy and social rhythm in younger adult populations. These findings provide new insights for future research. Moreover, the longitudinal study displayed trends in the mental health of college students, which provided us with useful information regarding changes in college students' mental health.

This study has some limitations. First, all participants came from the same university, although they attended six different colleges. The results would be more reliable if we could have obtained a wider range of representative samples. In addition, the proportion of students (about 65%) who participated in the survey was relatively small. Second, self-reported measures were used to assess self-efficacy, social rhythm, and mental health. Multiple methods should be considered in future research to reduce the measurement errors. Finally, future longitudinal research could focus on finding other variables that predict the negative aspects of mental health, such as stress, depression, and anxiety.

Despite these limitations, this study preliminarily investigated the development trend and relationship between self-efficacy, social rhythm, and mental health through a 3-year longitudinal design of a large sample of college students. College students are at an important stage in their lives, which may result in changes to their mental health status. Such longitudinal research can make up for the inconsistent conclusions in previous studies regarding the general development trend of college students' mental health. Furthermore, the cross-lagged structural model for self-efficacy, social rhythm, and mental health showed that positive mental health had a greater impact on social rhythm and self-efficacy. In other words, college students with a high level of positive mental health are more likely to have a regular life and high self-efficacy. This emphasizes the importance of focusing on and helping college students improve their positive mental health in their daily lives. Accordingly, school psychologists in universities could set up relevant courses and form a variety of interest groups to enhance college students' sense of well-being and improve their levels of positive mental health. Furthermore, considering the impact of COVID-19, relevant departments must appeal to college students to properly arrange their diet sleeping

and social life, and form a regular social rhythm to enhance their self-efficacy. Thus, encouraging college students to maintain a regular social rhythm and strengthen their positive mental health to have a high level of self-efficacy when facing difficulties are of great significance.

Conclusion

The present study provides evidence of the longitudinal relationship between self-efficacy, social rhythm, and positive mental health among college students. The mutually reinforcing relationship between self-efficacy, social rhythm, and positive mental health differed during the college years. The developmental cascades of mental health, self-efficacy, and social rhythm does not hold, that is self-efficacy and social rhythm failed promote mental health via another one. However, positive mental health and social rhythm significantly predicted self-efficacy in the following year. Improving the positive mental health and keeping a regular social rhythm can further promote college students' self-efficacy and let them have a better quality of life.

Acknowledgments The authors acknowledge Prof. Jürgen Margraf and Dr. Xiao Chi Zhang of Ruhr-University Bochum for their great efforts in supervising this project. This work was supported by Shuguang Program supported by Shanghai Education Development Foundation and Shanghai Municipal Education Commission (20SG45).

Declarations

Conflict of Interest All authors declare that they have no conflict of interest.

Ethical Approval Ethical approval was obtained from the Research Ethics Committee of Corresponding Author's University. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Data Availability Statement The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

Abdel-Khalek, A. M., & Lester, D. (2017). The association between religiosity, generalized self-efficacy, mental health, and happiness in Arab college students. *Personality and Individual Differences, 109*, 12–16.

Angelika, S., Kulessa, & Gulewitsch. (2012). Sleep characteristics, sleep problems, and associations of self-efficacy among german university students. *Nature and Science of Sleep, 4*, 1–7.

Azizli, N., Atkinson, B. E., Baughman, H. M., & Giammarco, E. A. (2015). Relationships between general self-efficacy, planning for the future, and life satisfaction. *Personality and Individual Differences, 82*, 58–60.

Bai, K., Kohli, S., & Malik, A. (2017). Self-efficacy and hope as predictors of mental health. *Indian Journal of Positive Psychology, 8*(4), 631–635.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.

Bieda, A., Hirschfeld, G., Schönfeld, P., Brailovskaia, J., Lin, M., & Margraf, J. (2019). Happiness, life satisfaction and positive mental health: Investigating reciprocal effects over four years in a Chinese student sample. *Journal of Research in Personality, 78*, 198–209.

Bihlmaier, I., & Schlarb, A. A. (2016). Self-efficacy and sleep problems. *Somnologie, 20*(4), 275–280.

Boland, E. M., Bender, R. E., Alloy, L. B., Conner, B. T., Labelle, D. R., & Abramson, L. Y. (2012). Life events and social rhythms in bipolar spectrum disorders: An examination of social rhythm sensitivity. *Journal of Affective Disorders, 139*(3), 264–272.

Boland, E. M., Stange, J. P., LaBelle, D. R., Shapero, B. G., Weiss, R. B., Abramson, L. Y., & Alloy, L. B. (2016). Affective disruption from social rhythm and behavioral approach system (BAS) sensitivities: A test of the integration of the social zeitgeber and BAS theories of bipolar disorder. *Clinical Psychological Science, 4*(3), 418–432.

Cai, D., Zhu, M., Lin, M., Zhang, X. C., & Margraf, J. (2017). The bidirectional relationship between positive mental health and social rhythm in college students: A three-year longitudinal study. *Frontiers in Psychology, 8*, 1119.

Cairns, K. E., Yap, M., Pilkington, P. D., & Jorm, A. F. (2014). Risk and protective factors for depression that adolescents can modify: A systematic review and meta-analysis of longitudinal studies. *Journal of Affective Disorders, 169*, 61–75.

Carney, C. E., Edinger, J. D., Meyer, B., Lindman, L., & Istre, T. (2006). Daily activities and sleep quality in college students. *Chronobiology International, 23*(3), 623–637.

Villiers, D., Anniza, S. N., Draper, C. E., Hill, J., Gwebushe, N., & Lambert, E. V. (2016). Primary school children's nutrition knowledge, self-efficacy, and behavior, after a three-year healthy lifestyle intervention (HealthKick). *Ethnicity & Disease, 26*(2), 171–180.

Duan, W. (2016). Mediation role of individual strengths in dispositional mindfulness and mental health. *Personality and Individual Differences, 99*, 7–10.

Ehlers, C. L., Frank, E., & Kupfer, D. J. (1988). Social zeitgebers and biological rhythms. *Archives of General Psychiatry, 45*, 948–952.

Frank, E., Kupfer, D. J., Thase, M. E., Mallinger, A. G., Swartz, H. A., Fagiolini, A. M., Grochocinski, V., Houck, P., Scott, J., Thompson, W., & Monk, T. (2005). Two-year outcomes for interpersonal and social rhythm therapy in individuals with bipolar I disorder. *Archives of General Psychiatry, 62*(9), 996–1004.

Goldin, P. R., Ziv, M., Jazaieri, H., Werner, K., Kraemer, H., Heimberg, R. G., & Gross, J. J. (2012). Cognitive reappraisal self-efficacy mediates the effects of individual cognitive-behavioral therapy for social anxiety disorder. *Journal of Consulting and Clinical Psychology, 80*(6), 1034–1040.

Gorwood, P. (2012). Anxiety disorders and circadian rhythms. *Medicographica, 34*, 289–294.

Grandin, L. D., Alloy, L. B., & Abramson, L. Y. (2006). The social zeitgeber theory, circadian rhythms, and mood disorders: Review and evaluation. *Clinical Psychology Review, 26*(6), 679–694.

Hamilton, N. A., Nelson, C. A., Stevens, N., & Kitzman, H. (2007). Sleep and psychological well-being. *Social Indicators Research, 82*(1), 147–163.

Holden, G. (1991). The relationship of self-efficacy appraisals to subsequent health related outcomes: A meta-analysis. *Social Work in Health Care, 16*(1), 53–93.

Hu, S., Cai, D., Zhang, X. C., & Margraf, J. (2020). Relationship between social support and positive mental health: A three-wave longitudinal study on college students. *Current Psychology*, 1–10.

Iasiello, M., van Agteren, J., Keyes, C. L. M., & Cochrane, E. M. (2019). Positive mental health as a predictor of recovery from mental illness. *Journal of Affective Disorders, 251*, 227–230.

Jeyagurunathan, A., Vaingankar, J. A., Abdin, E., Sambasivam, R., Seow, E., Pang, S., Picco, L., Chong, S. A., & Subramaniam, M. (2017). Gender differences in positive mental health among individuals with schizophrenia. *Comprehensive Psychiatry, 74*, 88–95.

Julia, V., Angela, B., Saskia, S., André, W., & Jürgen, M. (2018). Lifestyle choices and mental health: A longitudinal survey with German and Chinese students. *BMC Public Health, 18*(1), 632.

Judge, T. A., Erez, A., Bono, J. E., & Thoresen, C. J. (2002). Are measures of self-esteem, neuroticism, locus of control, and generalized self-efficacy indicators of a common core construct? *Journal of Personality and Social Psychology, 83*(3), 693–710.

Kaneita, Y., Ohida, T., Osaki, Y., Tanihata, T., & Hayashi, K. (2007). Association between mental health status and sleep status among adolescents in Japan: A nationwide cross-sectional survey. *Journal of Clinical Psychiatry, 68*(9), 1426–1435.

Karademas, E. C., & Kalantzi-Azizi, A. (2004). The stress process, self-efficacy expectations, and psychological health. *Personality and Individual Differences, 37*(5), 1033–1043.

Karlsson, H. (2012). Problems in the definitions of positive mental health. *World Psychiatry, 11*, 106–107.

Keyes, C. L . M. (2006). Mental health in adolescence: Is American's youth flourishing? *American Journal of Orthopsychiatry, 76*, 395–402.

Keyes, C. L. M. (2007). Promoting and protecting mental health as flourishing: A complementary strategy for improving national mental health. *American Psychologist, 62*(2), 95–108.

Lamers, S. M. A., Westerhof, G. J., Glas, C. A. W., & Bohlmeijer, E. T. (2015). The bidirectional relation between positive mental health and psychopathology in a longitudinal representative panel study. *The Journal of Sitive Psychology, 10*(6), 553–560.

Lee, C. S., & Hayes-Skelton, S. A. (2018). Social cost bias, probability bias, and self-efficacy as correlates of behavioral action in social anxiety. *Behavior Modification, 42*(2), 175–195.

Lieverse, R., Vries, R., Hoogendoorn, A. W., Smit, J. H., & Hoogendijk, W. (2013). Social support and social rhythm regularity in elderly patients with major depressive disorder. *American Journal of Geriatric Psychiatry Official Journal of the American Association for Geriatric Psychiatry, 21*(11), 1144–1153.

Luszczynska, A., Gutiérrez Doña, B., & Schwarzer, R. (2005a). General self-efficacy in various domains of human functioning: Evidence from five countries. *International Journal of Psychology, 40*(2), 80–89.

Luszczynska, A., Scholz, U., & Schwarzer, R. (2005b). The general self-efficacy scale: Multicultural validation studies. *The Journal of Psychology, 139*(5), 439–457.

Margraf, J., Lavallee, K., Zhang, X., & Schneider, S. (2016). Social rhythm and mental health: A cross-cultural comparison. *PLoS One, 11*(3), e150312.

Masten, A. S., & Cicchetti, D. (2010). Editorial: Developmental cascades. *Development and Psychopathology, 22*(3), 491–495.

Mental Health Government. (2020). *What Is Mental Health?* U.S. department of health and human services. Retrieved from https://www.mentalhealth.gov/basics/what-is-mental-health

Morgan, K. (2003). Daytime activity and risk factors for late-life insomnia. *Journal of Sleep Research, 12*(3), 231–238.

Pallant, J. F. (2000). Development and validation of a scale to measure perceived control of internal states. *Journal of Personality Assessment, 75*(2), 308–337.

Parto, M. (2011). Problem solving, self-efficacy, and mental health in adolescents: Assessing the mediating role of assertiveness. *Procedia - Social and Behavioral Sciences, 30*, 644–648.

Peach, H., Gaultney, J. F., Gray, D. D., & Walla, P. (2016). Sleep hygiene and sleep quality as predictors of positive and negative dimensions of mental health in college students. *Cogent Psychology, 3*(1), 1168768.

Pilcher, J. J., & Ott, E. S. (1998). The relationships between sleep and measures of health and well-being in college students: A repeated measures approach. *Behavioral Medicine, 23*(4), 170–178.

Przepiórka, A., Błachnio, A., & Siu, N. Y. (2019). The relationships between self-efficacy, self-control, chronotype, procrastination and sleep problems in young adults. *Chronobiology International, 36*(8), 1025–1035.

Ryff, C. D., & Keyes, C. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology, 69*(4), 719–727.

Salgado-Delgado, R., Tapia Osorio, A., Saderi, N., & Escobar, C. (2011). Disruption of circadian rhythms: A crucial factor in the etiology of depression. *Depression Research and Treatment, 2011*, 1–9.

Sandin, B., Sánchez-Arribas, C., Chorot, P., & Valiente, R. M. (2015). Anxiety sensitivity, catastrophic misinterpretations and panic self-efficacy in the prediction of panic disorder severity: Towards a tripartite cognitive model of panic disorder. *Behaviour Research and Therapy, 67*, 30–40.

Schlarb, A. A., Kulessa, D., & Gulewitsch, M. D. (2012). Sleep characteristics, sleep problems, and associations of self-efficacy among German university students. *Nature and Science of Sleep, 4*, 1–7.

Schönfeld, P., Brailovskaia, J., Bieda, A., Zhang, X. C., & Margraf, J. (2016). The effects of daily stress on positive and negative mental health: Mediation through self-efficacy. *International Journal of Clinical and Health Psychology, 16*(1), 1–10.

Schwarzer, R. (1993). *Measurement of perceived self-efficacy. Psychometric scales for cross-cultural research.* Berlin, Germany: FreieUniversität Berlin.

Schwarzer, R., Mueller, J., & Greenglass, E. (1999). Assessment of perceived general self-efficacy on the internet: Data collection in cyberspace. *Anxiety, Stress & Coping, 12*(2), 145–161.

Shen, G. H., Alloy, L. B., Abramson, L. Y., & Sylvia, L. G. (2008). Social rhythm regularity and the onset of affective episodes in bipolar spectrum individuals. *Bipolar Disorders, 10*(4), 520–529.

Shojaei, M., Shamsipour Dehkordi, P., & Mootabadi, M. (2018). The mediation role of physical activity level on quality of working life and memory self-efficacy beliefs in staff with different circadian rhythms. *Iranian Journal of Health Psychology, 1*(2), 55–64.

Singh, K., & Junnarkar, M. (2015). Correlates and predictors of positive mental health for school going children. *Personality and Individual Differences, 76*, 82–87.

Skaalvik, E. M., & Skaalvik, S. (2017). Motivated for teaching? Associations with school goal structure, teacher self-efficacy, job satisfaction and emotional exhaustion. *Teaching and Teacher Education, 67*, 152–160.

Sylvia, L. G., Alloy, L. B., Hafner, J. A., Gauger, M. C., Verdon, K., & Abramson, L. Y. (2009). Life events and social rhythms in bipolar spectrum disorders: A prospective study. *Behavior Therapy, 40*(2), 131–141.

Sylvia, L. G., Thase, M. E., Reilly-Harrington, N. A., Salcedo, S., Brody, B., Kinrys, G., Kemp, D., Shelton, R. C., McElroy, S. L., Kocsis, J. H., Bobo, W. V., Kamali, M., McInnis, M., Friedman, E., Tohen, M., Bowden, C. L., Ketter, T. A., Singh, V., Calabrese, J., … Deckersbach, T. (2015). Psychotherapy use in bipolar disorder: Association with functioning and illness severity. *Australian and New Zealand Journal of Psychiatry, 49*(5), 453–461.

Teismann, T., Forkmann, T., Brailovskaia, J., Siegmann, P., Glaesmer, H., & Margraf, J. (2018). Positive mental health moderates the association between depression and suicide ideation: A longitudinal study. *International Journal of Clinical and Health Psychology, 18*(1), 1–7.

Velten, J., Bieda, A., Scholten, S., Wannemüller, A., & Margraf, J. (2018). Lifestyle choices and mental health: A longitudinal survey with German and Chinese students. *BMC Public Health, 18*(1), 632.

Velten, J., Lavallee, K. L., Scholten, S., Meyer, A. H., Zhang, X. C., Schneider, S., & Margraf, J. (2014). Lifestyle choices and mental health: A representative population survey. *BMC Psychology, 2*(1), 58.

Wang, P., Xiong, Z., & Yang, H. (2018). Relationship of mental health, social support, and coping styles among graduate students: Evidence from Chinese universities. *Iranian Journal of Public Health, 47*(5), 689–697.

Westerhof, G. J., & Keyes, C. (2010). Mental illness and mental health: The two continua model across the lifespan. *Journal of Adult Development, 17*(2), 110–119.

Wever, R. A. (1979). Influence of physical workload on freerunning circadian rhythms of man. *Pflugers Archiv - European Journal of Physiology, 381*(2), 119–126.

Wu, Y., Sang, Z., Zhang, X., & Margraf, J. (2020). The relationship between resilience and mental health in Chinese college students: A longitudinal cross-lagged analysis. *Frontiers in Psychology, 11*, 108.

Yiengprugsawan, V., Somboonsook, B., Seubsman, S., & Sleigh, A. C. (2012). Happiness, mental health, and socio-demographic associations among a national cohort of Thai adults. *Journal of Happiness Studies: An Interdisciplinary Forum on Subjective Well-Being, 13*(6), 1019–1029.

Yue, X. D., Hiranandani, N. A., Jiang, F., Hou, Z., & Chen, X. (2017). Unpacking the gender differences on mental health: The effects of optimism and gratitude. *Psychological Reports, 120*(4), 639–649.

Zhang, R., Ewalds-Kvist, B. M., Li, D., & Jiang, J. (2019). Chinese students' satisfaction with life relative to psychological capital and mediated by purpose in life. *Current Psychology, 38*, 260–271.

Zhang, G., Yang, X., Tu, X., Ding, N., & Lau, J. T. F. (2020). Prospective relationships between mobile phone dependence and mental health status among Chinese undergraduate students with college adjustment as a mediator. *Journal of Affective Disorders, 260*, 498–505.

Zhang, J. X., & Schwarzer, R. (1995). Measuring optimistic self-beliefs: A Chinese adaptation of the general self-efficacy scale. *Psychologia: An International Journal of Psychology in the Orient, 38*(3), 174–181.