



Research article

Social support and subjective well-being among postgraduate medical students: the mediating role of anxiety and the moderating role of alcohol and tobacco use

Zewen Huang^{a, **}, Lejun Zhang^b, Junyu Wang^c, Lu Xu^d, Zhuang Liu^a, Tingting Wang^a, Ming Guo^e, Xi Xu^e, Heli Lu^{e, *}^a Faculty of Medicine, Macau University of Science and Technology, Macau, China^b School of Psychology, South China Normal University, Guangzhou, Guangdong, China^c The School of Cyberspace, Hangzhou Dianzi University, Hangzhou, Zhejiang, China^d School of Psychology and Cognitive Science, East China Normal University, Shanghai, China^e The Department of Psychosomatic Medicine, The Second Affiliated Hospital of Nanchang University, Nanchang, Jiangxi, China

ARTICLE INFO

Keywords:

Medical students
Subjective well-being
Social support
Anxiety
Alcohol and tobacco use

ABSTRACT

Medical students often face pressures from various sources in the course of postgraduate studies, and these factors have a negative impact on their subjective well-being. Previous researches have revealed that social support is a vital factor influencing subjective well-being, but unfortunately the underlying mechanism for this is unclear, especially for postgraduate medical students. The current study has inspected the effects of social support on subjective well-being of postgraduate medical students, the mediating role of anxiety and the moderating role of alcohol and tobacco use in the association between social support and subjective well-being of postgraduate medical students. A sample of 900 postgraduate medical students (Mage = 27.01 years, SD = 3.33) from The Second Affiliated Hospital of Nanchang University completed the Social Support Rating Scale, the Generalized Anxiety Disorder-7, the Tobacco and Alcohol Use Questionnaire and the Subjective Well-Being Scale. Analysis of the structural equation model revealed that anxiety partially mediated the relationship between social support and subjective well-being of postgraduate medical students, while alcohol and tobacco use moderated the relationship between anxiety and subjective well-being of postgraduate medical students. This study revealed how social support act upon subjective well-being of postgraduate medical students. This study provides a theoretical basis for promoting and enhancing the subjective well-being of postgraduate medical students.

1. Introduction

With postgraduates' enrollment expansion in China, their mental health was increasingly of concern to scholars, since most of them in the age of 25–35, were generally under pressure from various aspects such as academic, economic, marriage, interpersonal, and employment, and their mental and physical health were vulnerable to damage (Zhou, 2016). As a special group of postgraduates, in addition to the above-mentioned pressures, postgraduate medical students in affiliated hospitals of university were also subjected to pressures in terms of relationships with laboratory staff, colleagues in rotating departments, and doctor-patient relationships (Wang et al., 2019). Meanwhile, the

internship life in medical schools and hospitals was a significant source of psychological issues and emotional distress for students, who frequently face stress from financial, life and academic aspects during the period (Thuma et al., 2020). Back in 2010 the UK government announced well-being as a key indicator of social progress (Dolan et al., 2011). Current studies have increasingly attached importance to the positive effects of well-being on physical and mental health, longevity, prevention of mental illness, and attitude toward life (Diener et al., 2017; Diener et al., 2018; Neufeld and Malin, 2020). For instance, individuals having elevated levels of well-being had higher creativity levels, improved immune systems, better relationships with other people and they will also be more efficient in their job and live longer (Cetin et al., 2021). And

** Corresponding author.

* Corresponding author.

E-mail addresses: 2009853vhp20001@student.must.edu.mo (Z. Huang), luheli0902@163.com (H. Lu).<https://doi.org/10.1016/j.heliyon.2021.e08621>

Received 24 August 2021; Received in revised form 19 September 2021; Accepted 14 December 2021

2405-8440/© 2021 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

focusing on the positive effects of well-being and how to improve it can better help postgraduate medical students to cope with the stress from various aspects (Nagji et al., 2013). Therefore, for medical students under grand pressure due to the long cycle of medical education and heavy schoolwork, their well-being should be paid more attention to (Biro et al., 2010). Nevertheless, for postgraduate medical students, the influencing factors and specific bearing upon mechanism of subjective well-being are still not clear enough. Most of the previous empirical studies have focused on the factors influencing the well-being of medical students and the correlation between well-being and other factors (Saleem and Saleem, 2017; Salehi et al., 2017; Vollmer-Conna et al., 2020), while the specific mechanisms influencing subjective well-being of postgraduate medical students and the joint relationship among the influencing factors have been little explored. Therefore, we aimed at erecting on previous research and introducing factors related to well-being into a structural equation model to explore whether subjective well-being is influenced by social support among postgraduate medical students and unpack the potential mediating and moderating mechanisms in this relationship, in order to further decipher the specific process in this impact pathway and provide a theoretical basis for improving subjective well-being of postgraduate medical students.

1.1. Social support and subjective well-being

Social relationship can be divided into emotional support, instrumental support and informational support (Cai et al., 2021). Among all the support, emotional support was a particularly important role, emotional support could predict subjective well-being of nursing students significantly (Senocak and Demirkiran, 2020). Subjective well-being was a comprehensive psychological concept measure the individual quality of life, which was composed of the presence of positive affect, the absence of negative affect and satisfaction (Joshanloo et al., 2018). Humanistic psychological theory pointed out that their corresponding subjective well-being would also be improved when the specific needs of individuals are satisfied, which was also the empirical basis for Abraham Maslow's theory of self-actualization (Maslow, 1943). Just as Maslow (1943) assumed that social support was related to love and belonging and self-esteem in needs. On the one hand, emotional support in social support meant that offering encouragement to others, showing concern and love, and accompanying people in the face of difficulties, which made people to be cared for and valued (Cai et al., 2021). On the other hand, social support has a positive impact on the development of self-esteem, especially during adolescence, and promotes an individual's perception of his or her own worth and self-worth. Therefore, social support can significantly promote people's subjective well-being (Rueger et al., 2016; Li et al., 2018). Meanwhile, an entire series of empirical studies have explored the relationship between social support and subjective well-being. For example, students' relationships with teachers and other students in the school environment were consistently predictive of a broad range of subjective well-being (Litlecott et al., 2018). Further, emotional support could also predict subjective well-being significantly (Morelli et al., 2015; Wang et al., 2021). Social support was positively associated with well-being (Sharda et al., 2019). And the positive effect of social support on the well-being should also be highlighted to healthcare professionals (Khusaifan and El Keshky, 2020).

1.2. Anxiety as a mediating role

Anxiety is a sustained mental health disorder that can be triggered by stress. One feasible candidate to mediate the relationship between social support and subjective well-being is anxiety (Cordner et al., 2021). On the one hand, people with adequate social support were likely to get more help from family, friends or classmates and may also have the resources and capacity to tackle negative affection when they are affected by negative events. So social support is one of the coping mechanisms for

stress, medical students who seek social support more likely to be satisfied with their own lives (Park et al., 2015). Social support was also correlated and negatively predicted anxiety (Jahan et al., 2016). Moreover, in the context of medical education, previous study has found that there is a strong correlation between group membership and well-being (Casapulla et al., 2020). Empirical studies also indicated social support and mental health are closely related (Peng et al., 2012). More specifically, social support may result in medical students feeling less anxious when they have difficulty in acquiring medical expertise and clinical skills (Popescu and Buzoianu, 2017). On the other hand, anxiety has been shown to be negatively related to subjective well-being, that is, the higher the level of anxiety, the lower the level of subjective well-being (Hanna and Strober, 2020). For example, anxiety and depression are negative emotions with a high incidence in postgraduate, which has a significant impact on their subjective well-being (van Vuuren et al., 2021). According to the goal theory, subjective well-being came from the satisfaction of needs or the achievement of goals. Generally speaking, when goals and needs are in line, the satisfaction of needs will increase positive emotions and further promote the improvement of subjective well-being (Diener, 1999). Subsequent empirical studies have also supported the goal theory, finding that personality traits could affect subjective well-being through emotional balance (The level of positive emotion minus the level of negative emotion) (Schimmack et al., 2002). Based on the empirical grounds reviewed above, social support can meet individual needs of safety needs, love and belonging, leading to better health and less chance of anxiety later in life. It is possible that medical students with a persisting lower level of anxiety may embrace the challenge with enthusiasm and adapt life and society more easily, which can promote to improve subjective well-being. Following this line of logic, we propose the first hypothesis: hypothesis 1. Anxiety can mediate the relationship between social support and subjective well-being of postgraduate medical students.

1.3. Alcohol and tobacco use as a moderating role

Although social support may influence subjective well-being via anxiety, other factors may influence the effect of this process. According to the risk and resilience framework, risk factors decrease the level of subjective well-being, while protective factors weaken the negative impact of risk factors (Yang et al., 2021). Specifically, we inspect whether social support can buffer against the adverse effects of pressure of medical students on subjective well-being. And alcohol and tobacco use may play an important role in the relationship, it may further moderate (exacerbate or buffer) the association between social support and subjective well-being of postgraduate medical students. Excessive use of alcohol and tobacco can undoubtedly have many negative effects on the physical and mental health of postgraduate medical students (Goel et al., 2015). Quite a few researches have found that alcohol and tobacco use were common experiences in medical students during their college (Gignon et al., 2015; Leon-Seminario and Pena-Sanchez, 2018). The previous study has illustrated that anxiety and other negative emotions led some people to use tobacco and alcohol as a coping strategy (Baeza-Velasco et al., 2015). Research has shown that patients with alcohol use disorder had higher anxiety level than normal people, and alcohol use disorder patients with anxiety also had lower well-being (Lucy and Maree, 2002; Agabio et al., 2021). Moreover, reducing the frequency of smoking can be efficient in promoting mental health and increasing well-being (Shan et al., 2020). Therefore, alcohol and tobacco use may exert a negative influence on the process of social support influencing subjective well-being, soaring anxiety and reducing subjective well-being of postgraduate medical students. There is, however, another possibility: protective factors were stimulated by the low level of risk underlies challenge model (Luthar and Zelazo, 2003). According to challenge model, alcohol and tobacco use as a risk factor may have triggered a protective effect of social support during graduate student age of medical students and reduced negative effects contributed by stress. However, so

far, no studies have explored this influence pathway in more detail. In conclusion, we propose the second hypothesis: hypothesis 2. Alcohol and tobacco use will moderate direct and indirect relations between social support and subjective well-being of postgraduate medical students via anxiety.

1.4. Present study

Based on the above empirical studies and evidence from various fields, we propose the following hypotheses (see Figure 1):

Hypothesis 1. Anxiety will mediate the relation between social support and subjective well-being.

Hypothesis 2. Alcohol and tobacco use will moderate direct and indirect relations between social support and subjective well-being of postgraduate medical students via anxiety.

2. Method

2.1. Participants and procedure

Before commencing the survey, we used Monte Carlo methods to calculate the sample size of the study. We used Monte Carlo methods to estimate the sample size (Thoemmes et al., 2010; Huang et al., 2021). We set the path coefficient based on the results of previous studies and pre-surveys (Tan et al., 2018; Jenna et al., 2020; Khusaifan and El Keshky, 2021). The results showed that statistical testing power of each path of the model exceeds 0.90 after the sample size reached 850. Therefore, we believed that the sample size of this study should exceed 850. The study was approved by Medical Research Ethics Committee of The Second Affiliated Hospital of Nanchang University and also obtained informed consent from the participants and hospital administrators. Participants were recruited from the graduate faculty of The Second Affiliated Hospital of Nanchang University. Firstly, under medical ethics standards, we checked the data left by the participants in the previous general survey of mental health and reconfirmed the background information of the study participants with the graduate faculty of the affiliated hospital of university, and we excluded those participants who had a previous diagnosis of psychiatric disorders in their self-report, previous data or background information. Secondly, we sought the University's consent to conduct the study within the university, and the study was conducted through an on-campus census in which all 933 postgraduate medical students from the University Hospital voluntarily agreed to participate in this study. Thirdly, we distributed WeChat QR codes to each class WeChat group, and our study participated in the questionnaire responses by scanning the QR codes online. In the end, we placed two trained volunteers in each WeChat group to facilitate answering questions raised by participants at any time. At the same time, we set three polygraph questions in the questionnaire, and only if a participant answered all the polygraph questions correctly, his study data would be included in the study. All participants were rewarded with a certain number of course credits after the research study. After excluding participants who did not meet the experimental conditions, a sum of 900 students completed the survey and 453(50.33%) of the participants was males. The mean age of the participants was 27.01 (SD age = 3.33, range = 22–57).

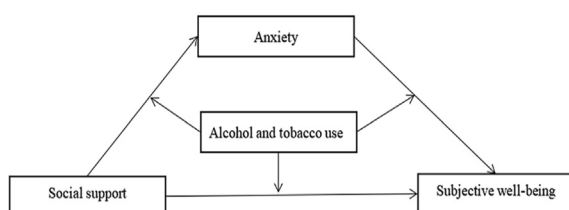


Figure 1. The moderated mediation model.

2.2. Measures

2.2.1. Measurement of social support

Social Support Rating Scale (SSRS). SSRS has ten items that measure three dimensions: subjective support, objective support, and utilization of support (Xiao, 1994). The scale scores ranged from 11–62. The Cronbach alpha of the three subscales were 0.66, 0.60 and 0.63, respectively. The Cronbach alpha in this study for this assessment was 0.72.

2.2.2. Measurement of anxiety

Generalized Anxiety Disorder-7 (GAD-7). The GAD-7 was a 7-item screener designed to assess for the presence of generalized anxiety disorder (Ruiz et al., 2011). The scale scores ranged from 0–28. The reliability and validity of the Chinese version of the GAD-7 were good (Qu and Sheng, 2015). The scale is scored on a 4-point scale. The Cronbach alpha in this study for this assessment was 0.93.

2.2.3. Measurement of alcohol and tobacco use

Tobacco and Alcohol Use Questionnaire (Ye et al., 2011). It consisted of four items, including the frequency and quantity of alcohol and tobacco use. The scale scores ranged from 0–24. The scale was based on a six-point scale. Tobacco and alcohol use questionnaire has been used in many studies to examine alcohol and tobacco use of individuals, in previous studies, the Cronbach alpha of the scale ranged from 0.80 to 0.82 (Xia and Ye, 2014, 2016; Yi et al., 2016). The Cronbach alpha of the tobacco subscale and alcohol subscale were 0.84 and 0.90, respectively. The Cronbach alpha in this study for this assessment was 0.72.

2.2.4. Measurement of subjective well-being

Subjective Well-Being Scale (Campbell, 1976). There was only one item, which was “In general, how happy are you?”. The scale scores ranged from 1–7. Individual rate the degree of well-being on a 7-point Likert-scale. The single question scale of subjective well-being has been used in many studies to examine the subjective well-being of individuals (Xin and Chi, 2001; Xiong and Xu, 2009). Satisfaction With Life Scale (Diener et al., 1985) was used as the criterion-related validity scale to calculate the criterion-related validity of subjective well-being scale. The Chinese version of the scale has been widely adopted in measuring life satisfaction among Chinese people (Zhu and Shek, 2020; Zhou et al., 2021). The Cronbach alpha of Satisfaction With Life Scale in this study for this assessment was 0.91. The criterion validity of subjective well-being scale was 0.69.

3. Result

3.1. Common method bias

The Harman single-factor test was used to test for common method bias, and the results showed that the explanatory rate of the first common factor was only 31.59%, which was far below the threshold of 40%, so it was judged that the common method bias did not affect this study.

3.2. Preliminary analysis

Correlation analysis showed that social support was positively associated with subjective well-being. However, social support was negatively correlated with anxiety. And anxiety was positively correlated with alcohol and tobacco use. Moreover, there was a negative association between anxiety and subjective well-being. And alcohol and tobacco use were negatively correlated with subjective well-being (see Table 1).

3.3. Testing for the mediation model

First, we hypothesized that anxiety mediates the role between social support and subjective well-being. We used PROCESS macro (Model 4) to test for mediating effects. After age and gender were controlled for, social

Table 1. Correlations between variables.

Variables	1	2	3	4
Social support	—			
Anxiety	-0.28***	—		
Alcohol and tobacco use	-0.002	0.11***	—	
Subjective well-being	0.43***	-0.36***	-0.07*	—
M	35.81	8.60	1.11	4.89
SD	6.43	2.92	0.37	0.92

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. $N = 900$.

support can have a negative predictive effect on anxiety of postgraduate medical students ($\beta = -0.28, p < 0.001$, bootstrap 95%CI [-0.19, -0.06]), and anxiety can also negatively predict subjective well-being ($\beta = -0.26, p < 0.001$, bootstrap 95%CI [-0.35, -0.22]). Additionally, the residual direct effect was significant ($\beta = 0.37, p < 0.001$, bootstrap 95%CI [0.31, 0.42]), which meant that anxiety partly mediated the effort of social support on subjective well-being (mediating effect = 0.07, bootstrap 95%CI [0.05, 0.10]) (see Figure 2). This mediating effect accounted for 16.28% of the total effect of social support on subjective well-being. Therefore, hypothesis 1 was supported.

3.4. Testing for the moderating role of alcohol and tobacco use in the mediation model

Second, we examined whether alcohol and tobacco use moderated all pathways between social support and subjective well-being via anxiety (see Figure 3). We used PROCESS macro (Model 59) to test for moderating effects of alcohol and tobacco use. In Model 1, we estimated the moderating role of alcohol and tobacco use in the relationship between social support and anxiety. In Model 2, we estimated the moderating role of alcohol and tobacco use in the relationship between social support and subjective well-being and in the relationship between anxiety and subjective well-being. As shown in Table 2, after controlling for age and gender, Model 1 indicated that social support was associated with anxiety ($\beta = -0.28, p < 0.001$, bootstrap 95%CI [-0.34, -0.22]). But alcohol and tobacco use didn't moderate the effect of social support on anxiety ($\beta = -0.002, p > 0.05$, bootstrap 95%CI [-0.06, 0.06]). Model 2 showed that anxiety negatively predicted subjective well-being ($\beta = -0.28, p < 0.001$, bootstrap 95%CI [-0.34, -0.22]). Meanwhile, the pathway between anxiety and subjective well-being of postgraduate medical students was significantly moderated by alcohol and tobacco use ($\beta = 0.06, p < 0.05$, bootstrap 95%CI [0.01, 0.10]). To further explore the mechanisms by which anxiety influences subjective well-being, we used the simple slope test to analyse this relationship, results revealed that for postgraduate medical students with low incidence of alcohol and tobacco use ($M-1SD$), a high level of anxiety was associated with low level of subjective well-being ($\beta_{simple} = -0.36, p < 0.001$). Meanwhile, for postgraduate medical students with high incidence of alcohol and tobacco use ($M+1SD$), the effect of anxiety on subjective well-being was further heightened ($\beta_{simple} = -0.53, p < 0.001$) (see Figure 4). Thus, anxiety has a more significant

predictive effect of subjective well-being for postgraduate medical students with high incidence of alcohol and tobacco use. In addition, social support was related to subjective well-being ($\beta = 0.37, p < 0.001$, bootstrap 95%CI [0.31, 0.43]). But alcohol and tobacco use wasn't found to moderate the effect of social support on subjective well-being of postgraduate medical students ($\beta = -0.03, p > 0.05$, bootstrap 95%CI [-0.10, 0.03]). Results indicated that anxiety predicted subjective well-being of postgraduate medical students, alcohol and tobacco use further heightened predictive role of anxiety. Alcohol and tobacco use moderated the relation between anxiety and subjective well-being, so hypothesis 2 was partly supported.

4. Discussion

Many prior studies have shown the importance of social support in promoting well-being (Sanchez-Sandoval et al., 2019; Cobo-Rendón et al., 2020; Xie et al., 2020), as an example, for medical students, the role of social support in promoting a greater sense of well-being was evident (Biro et al., 2010). This is compatible with our research results. However, it is not known how social support works and what factors influence the effect of social support on subjective well-being in this process. It is therefore important to build on previous research to investigate the factors influencing medical students' subjective well-being and to further explore the extent of these latent mechanisms of subjective well-being in postgraduate medical students. This study explores the mechanisms and potential influences of this by constructing structural equation models to examine how social support generated subjective well-being, whether anxiety mediated that relationship, and how alcohol and tobacco use might moderate the relationship between social support and postgraduate medical students' subjective well-being. Our results suggested that social support effectively predicts subjective well-being in postgraduate medical students and that anxiety partially mediated this process. That is, social support decreased anxiety, which also increased subjective well-being in turn. In addition, the second stage of this process was moderated by alcohol and tobacco use. The relationship between anxiety and subjective well-being became weaker for postgraduate medical students who smoke and drink less.

4.1. The mediating role of anxiety

On the one hand, the results of mediation model indicated that social support promoted the activation of anxiety mechanisms, it meant that good social support could promote the reduction in anxiety levels. This finding was consistent with previous literature on social support and anxiety, whereby social support was an important factor in anxiety (Tiffany et al., 2013; Majumdar et al., 2018; Viseu et al., 2018). Social support is a resource for individuals to cope with stress, the higher the level of social support perceived and available to individuals, the lower the level of anxiety they will perceive when they encounter stressful circumstance and events in life (Xing et al., 2016). Indeed, those who have not got enough social support might be more sensitive to changes in their environment and were prone to feel anxious when faced with various stressful events (Leis and Gallegos, 2018). On the other hand, contemporary study found that anxiety was negatively and significantly related to lower subjective well-being. One may argue that medical students are unique from other college students, which is, as medical education is famed for long learning period, complex expertise, and difficult clinical skill for medical students (Shim et al., 2016), which further makes anxiety affect subjective well-being of postgraduate medical students more obviously. As our model shows, anxiety partly mediated the association between social support and subjective well-being. That is, social support not only can affect subjective well-being directly, but also can through anxiety. The association between social support and subjective well-being may suggest that anxiety plays a special role in their graduate school time, and it is of great significance to diminish the level of anxiety to promote subjective well-being of postgraduate medical students. In summary, these

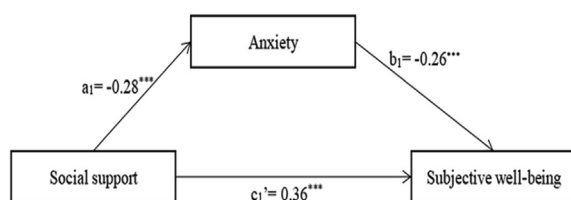


Figure 2. The mediation of anxiety. The link between social support and subjective well-being of postgraduate medical students was mediated by anxiety. The path values are the path coefficients. Change to: age and gender were controlled during this analysis. Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. $N = 900$.

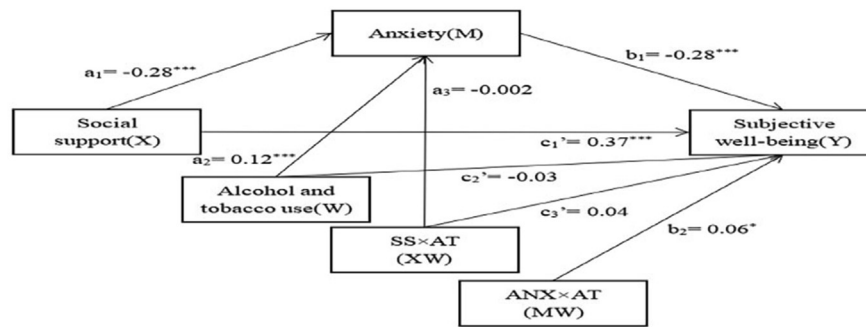


Figure 3. The moderated mediation model for subjective well-being. Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. $N = 900$. Note. SS = social support, ANX = anxiety, AT = alcohol and tobacco use, SWB = subjective well-being. $N = 900$.

Table 2. Testing the moderated mediation effects of social support on subjective well-being of postgraduate medical students.

Model	Predictors	Coeff.	SE	t	95%CI
Model 1 (ANX)	Age	0.001	0.01	0.37	[-0.01, 0.03]
	Gender	0.13	0.07	1.96	[-0.0002, 0.26]
	SS	-0.28	0.03	-8.70	[-0.34, -0.22]
	AT	0.12	0.03	3.62	[0.06, 0.19]
	SS x AT	-0.002	0.03	-0.06	[-0.06, 0.06]
	R ²	0.10			
	F	18.83			
Model 2 (SWB)	Age	-0.01	0.01	-1.12	[-0.03, 0.01]
	Gender	0.21	0.06	3.58	[0.10, 0.33]
	SS	0.37	0.03	12.19	[0.31, 0.43]
	AT	-0.03	0.03	-1.02	[-0.10, 0.03]
	SS x AT	0.04	0.03	1.38	[-0.02, 0.01]
	ANX	-0.28	0.03	-9.04	[-0.34, -0.22]
	ANX x AT	0.06	0.02	2.66	[0.01, 0.10]
	F	47.11			

influences were not independent of each other, but were interrelated. Social support can also directly provide postgraduate medical students with material support and emotional help, boosting the provision of postgraduate medical students' subjective well-being. The study results demonstrate that the promotion and improvement of postgraduate medical students' subjective well-being should take into account the impact of social support, anxiety and other co-factors.

4.2. The moderating role of alcohol and tobacco use

Our findings also suggest that alcohol and tobacco use can moderate the relationship between anxiety and subjective well-being. The pattern

was consistent with the previous study and showed that the effects of anxiety on subjective well-being were stronger in postgraduate medical students with high incidence of alcohol and tobacco use than in those who with low incidence of alcohol and tobacco use. There were some possible expositions for these findings. Social support refers to the degree of spiritual and material connection between individuals and diverse aspects of society, including social individuals and social organizations. In stress research, social support refers to the exterior resources available to individuals in the process of stress (Ye and Dai, 2008). According to Windle's research, impulsive social support has a buffering effect on stress, and the social support of intimate interpersonal relationship can significantly reduce the sense of stress of college students (Windle, 1992). Moreover, peer' perceived support system has less negative emotions and are more optimistic and hopeful, which further contributes to increased life satisfaction of students (Hakimzadeh et al., 2016). Individuals with a well-established social support system also have less negative emotions and are more optimistic and hopeful, which further contributes to increased life satisfaction (Suldo et al., 2009). Therefore, adequate social support will relieve stress and decrease negative emotion, further improve life satisfaction which finally brings about the improvement of the well-being (Yan et al., 2011). Previous research has shown that to cope with stress caused by obtaining medical knowledge and training skills, some physicians self-medicate with alcohol (Wijeratne et al., 2021) and increasing the risk of becoming heavy drinkers (Nguyen et al., 2018). Alcohol and tobacco use alleviate pressure and relieve fatigue, chiefly through the effect of physiological and psychological two aspects. On the one hand, nicotine and alcohol can reach the brain and bring feelings of pleasure and relief to the smoker or drinker. On the other hand, repetitive behavior can also reduce stress. But it can also motivate individuals to keep on using alcohol and tobacco, which is positive reinforcement. However, nicotine and alcohol are addictive substances, in gradual and repeated use, the body has a tolerance to nicotine and alcohol, that is, more nicotine and alcohol must be inhaled in order to achieve the same comfort as before, forming alcohol and tobacco addiction (Legaz et al., 2019). On the one hand, the stress and discomfort may cause by Learning

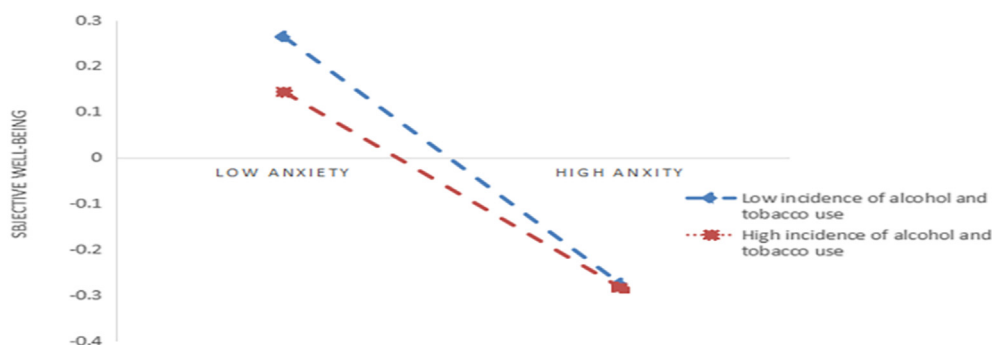


Figure 4. Conditional effect of alcohol and tobacco use as a function of anxiety and subjective well-being of postgraduate medical students. $M \pm 1SD$ of alcohol and tobacco use. $N = 900$.

medical theory and clinical work seem to be eased after smoking and drinking. However, after craving, the discomfort and stress come from a drop in nicotine and alcohol levels, and no smoking and drinking is even worse. On the other hand, in the long run, after getting used to the use of alcohol and tobacco to escape stress, the ability of medical postgraduates to solve problems from their studies and life satisfaction will also decrease, which will lead to a vicious circle, and they will be more prone to anxiety when facing stressful events that they cannot escape from, which will further reduce their subjective well-being. So after experiencing stress, alcohol and tobacco use can significantly amplify the negative impact of anxiety on subjective well-being of postgraduate medical students.

Contrary to our expectations, the direct path between social support and subjective well-being and the first stage of this intermediate process were not moderated by alcohol and tobacco use. This finding implies that anxiety is more like subjective experience, while social support is an external resource which is objective in existence. For most postgraduate medical students, social support not only directly affects the subjective feelings, but also improves their material environment including financial assistance, material resources, and needs financial help from family, friends and other group to improve subjective well-being. So in this process, social support can make changes to material surroundings, further contributes to subjective well-being by reducing anxiety of postgraduate medical students, while alcohol and tobacco use can only exacerbate or buffer the second half of this intermediate process (the process of subjective feeling).

4.3. Implications

The maintenance and enhancement of subjective well-being can effectively promote the psychological health of postgraduate medical students, and the monitoring and evaluation of subjective well-being of postgraduate medical students can also bring great social benefits, therefore, pouring attention to the subjective well-being of postgraduate medical students lays an important foundation for the training of practicing doctors in the national healthcare system.

Firstly, given that social support is an important factor affecting the subjective well-being of postgraduate medical students, therefore, it is important to help postgraduate medical students to strengthen their ties with their families and schools so as to establish an effective social support system for postgraduate medical students. University hospitals should offer interpersonal courses to improve the social skills of postgraduate medical students in the process of training them, thus helping them to better communicate and interact with their families, friends and classmates.

Secondly, anxiety played a mediating role in the effect of social support on subjective well-being of postgraduate medical students, this was an indication that social support was effective in reducing anxiety during their graduate school time, further promoting the well-being of postgraduate medical students.

Finally, alcohol and tobacco use had a negative effect on postgraduate medical students during this period. Alcohol and tobacco use affected the process by which anxiety affects subjective well-being. The negative effect of anxiety on subjective well-being was further amplified by the high incidence of tobacco and alcohol use. Therefore, university hospitals should establish a sound mental health assistance system in the process of training postgraduate medical students, help medical students to develop correct methods of emotion de-escalation and emotion management, reduce alcohol consumption and smoking in daily work, and further develop healthy habits.

4.4. Limitations and future directions

This study still has some limitations due to various significant aspects of the research process. Firstly, this study used a cross-sectional research design and extra care should be taken when inferred causality from the

findings. In a subsequent study we considered a longitudinal study to further determine the causal relationship between social support and subjective well-being. Second, our participants were all recruited from the same university hospital, therefore, the sample for the study may not be adequately representative. In subsequent studies we consider expanding the sample size and collaborating with other institutions to improve the representativeness of the sample. Finally, graduate school time is a specific period for medical students, so it is doubtful whether our findings will be consistent in other periods of medical education. In future research we wish to explore the factors influencing other stages of subjective well-being in medical students.

5. Conclusion

In summary, this study tested the mediating role of anxiety and the moderating role of alcohol and tobacco use by constructing structural equation models in order to explore the relationship between social support and subjective well-being among postgraduate medical students. Our study manifests that anxiety plays a partially mediating role in the way social support affects the subjective well-being of postgraduate medical students. Furthermore, our findings suggest that alcohol and tobacco use moderate the relationship between anxiety and subjective well-being. Thus, theoretically, these findings contribute to a better understanding of the potential mechanisms underlying that relationship; similarly, in practice, research has shown that valuing the role of social support, reducing anxiety and helping postgraduate medical students to reduce their alcohol and tobacco use can effectively develop and promote subjective well-being in postgraduate medical students.

Declarations

Author contribution statement

Zewen Huang, Lejun Zhang: Conceived and designed the experiments; Wrote the paper.

Junyu Wang, Lu Xu: Performed the experiments.

Zhuang Liu, Tingting Wang: Analyzed and interpreted the data.

Ming Guo, Xi Xu: Contributed reagents, materials, analysis tools or data.

Heli Lu: Conceived and designed the experiments.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

The authors do not have permission to share data.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

- Agabio, R., Baldwin, D.S., Amaro, H., Leggio, L., Sinclair, J.M.A., 2021. The influence of anxiety symptoms on clinical outcomes during baclofen treatment of alcohol use disorder: a systematic review and meta-analysis. *Neurosci. Biobehav. Rev.* 125, 296–313.
- Baeza-Velasco, C., Stoeber-Delbarre, A., Cousson-Gelie, F., Pailhez, G., Bulbena, A., Baguet, F., Gely-Nargeot, M.C., 2015. Increased tobacco and alcohol use among

- women with joint hypermobility: a way to cope with anxiety? *Rheumatol. Int.* 35 (1), 177–181.
- Biro, E., Balajti, I., Adany, R., Kosa, K., 2010. Determinants of mental well-being in medical students. *Soc. Psychiatr. Psychiatr. Epidemiol.* 45 (2), 253–258.
- Cai, T., Huang, Q., Yuan, C., 2021. Profiles of instrumental, emotional, and informational support in Chinese breast cancer patients undergoing chemotherapy: a latent class analysis. *BMC Wom. Health* 21 (1).
- Campbell, A., 1976. Subjective measures of well-being. *Am. Psychol.* 31, 117–124.
- Casapulla, S., Rodriguez, J., Nandyal, S., Chavan, B., 2020. Toward resilience: medical students' perception of social support. *J. Osteopath. Med.* 120 (12), 844–854.
- Cetin, M.B., Sezgin, Y., Akinci, S., Alptekin, N.O., 2021. Evaluating well-being among dental students using the Warwick-Edinburgh mental well-being scale and the relationship between mental well-being and socio-demographic findings. *Meand. Med. Dent. J.* 22 (2), 125–133.
- Cobo-Rendón, R., López-Angulo, Y., Pérez-Villalobos, M.V., Díaz-Mujica, A., 2020. Perceived social support and its effects on changes in the affective and eudaimonic well-being of Chilean university students. *Front. Psychol.* 11.
- Cordner, Z.A., MarshallThomas, I., Boersma, G.J., Lee, R.S., Potash, J.B., Tamashiro, K.L.K., 2021. Fluoxetine and environmental enrichment similarly reverse chronic social stress-related depression- and anxiety-like behavior, but have differential effects on amygdala gene expression. *Neurobiol. Stress* 15, 100392–100392.
- Diener, E., 1999. Subjective well-being: a 30-year process. *Acta Psychol. Sin.* 125.
- Diener, E., Emmons, R., Larsen, R.J., Griffin, S., 1985. The satisfaction with life scale. *J. Pers. Assess.* 49, 71–75.
- Diener, E., Heintzelman, S.J., Kushlev, K., Tay, L., Wirtz, D., Lutes, L.D., 2017. Findings all psychologists should know from the new science on subjective well-being. *Can. Psychol.* 58 (2), 87–104.
- Diener, E., Oishi, S., Tay, L., 2018. Advances in subjective well-being research. *Nat. Human Behav.* 2 (4), 253–260.
- Dolan, P., Layard, R., Metcalfe, R., 2011. Measuring Subjective Well-Being for Public Policy. An Office for National Statistics.
- Gignon, M., Havet, E., Ammirati, C., Traulle, S., Manaouil, C., Balcaen, T., Loas, G., Dubois, G., Ganry, O., 2015. Alcohol, cigarette, and illegal substance consumption among medical students A cross-sectional survey. *Workplace Health Saf.* 63 (2), 54–63.
- Goel, N., Khandelwal, V., Pandya, K., Kotwal, A., 2015. Alcohol and tobacco use among undergraduate and postgraduate medical students in India: a multicentric cross-sectional study. *Cent. Asian J. Glob. Health* 4 (1).
- Hakimzadeh, R., Besharat, M.A., Khaleghinezhad, S.A., Jahromi, R.G., 2016. Peers' perceived support, student engagement in academic activities and life satisfaction: a structural equation modeling approach. *Sch. Psychol. Int.* 37 (3), 240–254.
- Hanna, M., Strober, L.B., 2020. Anxiety and depression in multiple sclerosis (MS): antecedents, consequences, and differential impact on well-being and quality of life. *Mult. Sclerosis Relat. Disord.* 44.
- Huang, Z.W., Zhang, L.J., Wang, J.Y., Xu, L., Li, Y., Guo, M., Ma, J.B., Xu, X., Wang, B.Y., Lu, H.L., 2021. The structural characteristics and influential factors of psychological stress of urban residents in Jiangxi province during the COVID-19 pandemic: cross sectional study. *Heliyon* 7 (8).
- Jahan, F., Siddiqui, M.A., Mitwally, M., Al Zubidi, N.S.J., Al Zubidi, H.S.J., 2016. Perception of stress, anxiety, depression and coping strategies among medical students at Oman Medical College. *World Family Med.* 17 (4), 16–23.
- Jenna, M.W., Audrey, W., Natalie, J.S., 2020. Mindfulness, self-compassion, and savoring: factors that explain the relation between perceived social support and well-being. *Pers. Individ. Differ.* 152, 109568.
- Joshanloo, M., Sirgy, M.J., Park, J., 2018. Directionality of the relationship between social well-being and subjective well-being: evidence from a 20-year longitudinal study. *Qual. Life Res.* 27 (8), 2137–2145.
- Khusaifan, S.J., El Keshky, M.E., 2020. Social support as a protective factor for the well-being of parents of children with autism in Saudi Arabia. *J. Pediatr. Nurs.* 58, 1–7.
- Legaz, I., Perez-Carceles, M.D., de la Calle, I., Arjona, F., Roca, M., Cejudo, P., Luna, A., Osuna, E., 2019. Genetic susceptibility to nicotine and/or alcohol addiction: a systematic review. *Toxin Rev.*
- Leis, P.R., Gallegos, R.F., 2018. Relationship between social support, stress, anxiety and depression during pregnancy in a specific Mexican population. *Ansiedad Y Estrés-anxiety Stress* 24 (2-3), 67–72.
- Leon-Seminario, C., Pena-Sanchez, R., 2018. Consumption of alcohol and tobacco among medical students in the department of Lambayeque. *Revista Del Cuerpo Medico Del Hosp. Nacional Almanzor Aguinaga Asenjo* 11 (1), 12–17.
- Li, J., Han, X., Wang, W.S., Sun, G., Cheng, Z.M., 2018. How social support influences university students' academic achievement and emotional exhaustion: the mediating role of self-esteem. *Learn. Individ. Differ.* 61, 120–126.
- Littlecott, H.J., Moore, G.F., Murphy, S.M., 2018. Student health and well-being in secondary schools: the role of school support staff alongside teaching staff. *Pastor. Care Educ.* 36 (4), 297–312.
- Lucy, B., Maree, T., 2002. Alcohol use disorders comorbid with anxiety, depression and drug use disorders: findings from the Australian National Survey of Mental Health and Well Being. *Drug Alcohol Depend.* 68 (3), 299–307.
- Luthar, S.S., Zelazo, L.B., 2003. Research on resilience: an integrative review. In: Luthar, S.S. (Ed.), *Resilience and Vulnerability: Adaptation in the Context of Childhood Adversities*. Cambridge University Press, pp. 510–549.
- Majumdar, S., Lungwitz, E.A., Andrews, K.D., Chambers, J.E., Truitt, W.A., 2018. 12-Animal models to investigate social support induced anxiety reductions. *Integrat. Animal Human Res.* 224–240.
- Maslow, A.H., 1943. A theory of human motivation. *Psychol. Rev.* 50 (4), 370–396.
- Morelli, S.A., Lee, I.A., Arnn, M.E., Zaki, J., 2015. Emotional and instrumental support provision interact to predict well-being. *Emotion* 15 (4), 484–493.
- Nagji, A., Brett-MacLean, P., Breault, L., 2013. Exploring the benefits of an optional theatre module on medical student well-being. *Teach. Learn. Med.* 25 (3), 201–206.
- Neufeld, A., Malin, G., 2020. How medical students' perceptions of instructor autonomy-support mediate their motivation and psychological well-being. *Med. Teach.* 42 (4), 1–7.
- Nguyen, T.T.H., Sendall, M.C., White, K.M., Young, R.M., 2018. Vietnamese medical students and binge drinking: a qualitative study of perceptions, attitudes, beliefs and experience. *BMJ Open* 8 (4).
- Park, K.H., Kim, D.H., Kim, S.K., Yi, Y.H., Jeong, J.H., Chae, J., Hwang, J., Roh, H., 2015. The relationships between empathy, stress and social support among medical students. *Int. J. Med. Educ.* 6, 103–108.
- Peng, L., Zhang, J., Li, M., Li, P., Zhang, Y., Zuo, X., Miao, Y., Xu, Y., 2012. Negative life events and mental health of Chinese medical students: the effect of resilience, personality and social support. *Psychiatr. Res.* 196 (1), 138–141.
- Popescu, C.A., Buzoianu, A.D., 2017. Symptoms of anxiety and depression in Romanian and international medical students: relationship with big-five personality dimensions and social support. *Eur. Psychiatr.* 41, S625–S625.
- Qu, S., Sheng, L., 2015. Diagnostic test of screening generalized anxiety disorders in general hospital psychological department with GAD-7. *Chin. Ment. Health J.* 29 (12), 939–944.
- Rueger, S.Y., Malecki, C.K., Pyun, Y., Aycocock, C., Coyle, S., 2016. A meta-analytic review of the association between perceived social support and depression in childhood and adolescence. *Psychol. Bull.* 142, 1017–1067.
- Ruiz, M.A., Zamorano, E., Javier, G.C., Pardo, A., Freire, O., Rejas, J., 2011. Validity of the GAD-7 scale as an outcome measure of disability in patients with generalized anxiety disorders in primary care. *J. Affect. Disord.* 128 (3), 277–286.
- Saleem, S., Saleem, T., 2017. Role of religiosity in psychological well-being among medical and non-medical students. *J. Relig. Health* 56 (4), 1180–1190.
- Salehi, A., Marzban, M., Imanieh, M.H., 2017. Spiritual well-being and related factors in Iranian medical students. *J. Spirituality Ment. Health* 19 (4), 306–317.
- Sanchez-Sandoval, Y., Melero, S., Lopez-Jimenez, A.M., 2019. Mediating effects of social support in the association between problems in childhood and adolescence and well-being in adult domestic adoptees. *J. Happiness Stud.* 21.
- Schimmack, U., Diener, E., Oishi, S., 2002. Life-satisfaction is a momentary judgment and a stable personality characteristic: the use of chronically accessible and stable sources. *J. Pers.* 70, 345–385.
- Senocak, S.U., Demirkiran, F., 2020. Subjective well-being and influencing factors in Turkish nursing students: a cross-sectional study. *J. Pakistan Med. Assoc.* 70 (4), 630–635.
- Shan, L.P., Manzione, L.C., Azagba, S., 2020. Psychological well-being and dual-use of cigarettes and e-cigarettes among high school students in Canada. *J. Affect. Disord.* 265, 357–363.
- Sharda, E., Sutherby, C.G., Cavanaugh, D.L., Hughes, A.K., Woodward, A.T., 2019. Parenting stress, well-being, and social support among kinship caregivers. *Child. Youth Serv. Rev.* 99, 74–80.
- Shim, E.J., Jeon, H.J., Kim, H., Lee, K.M., Jung, D., Noh, H.L., Roh, M.S., Hahm, B.J., 2016. Measuring stress in medical education: validation of the Korean version of the higher education stress inventory with medical students. *BMC Med. Educ.* 16.
- Suldo, S.M., Friedrich, A.A., White, T., Farmer, J., Minch, D., Michalowski, J., 2009. Teacher support and adolescents' subjective well-being: a mixed-methods investigation. *Sch. Psychol. Rev.* 38 (1), 67–85.
- Tan, K., Ma, J., Lian, K., Guo, Z., Bai, X., 2018. Verbal working memory and reading ability of Chinese children with double-deficit developmental dyslexia. *Stud. Psychol. Behav.* 16 (3), 349–354.
- Thoemmes, F., Mackinnon, D.P., Reiser, M.R., 2010. Power analysis for complex mediational designs using Monte Carlo methods. *Struct. Equat. Model. Multidiscip. J.* 17 (3), 510–534.
- Thuma, T., Lawandy, M., Lotfalla, A., Mark, T., Christine, L., 2020. Mental health matters: mental health and overall well-being among first- and second-year medical students. *Health Prof. Educ.* 6 (4), 516–521.
- Tiffany, F., Miguel, D., Jeannette, B.S., 2013. Yoga and social support reduce prenatal depression, anxiety and cortisol. *J. Bodyw. Mov. Ther.* 17 (4), 397–403.
- van Vuuren, C.J., Bodenstein, K., Oberholzer, M., 2021. Exploring the psychological well-being of postgraduate accounting students at a South African university. *S. Afr. J. Antarct. Res.*
- Viseu, J., Leal, R., de Jesus, S.N., Pinto, P., Pechorro, P., Greenglass, E., 2018. Relationship between economic stress factors and stress, anxiety, and depression: moderating role of social support. *Psychiatr. Res.* 268, 102–107.
- Vollmer-Gonna, U., Beilharz, J.E., Cvejic, E., Macnamara, C.L., Doherty, M., Steel, Z., Hadzi-Pavlovic, D., Harvey, S.B., Parker, G., 2020. The well-being of medical students: a biopsychosocial approach. *Zealand J. Psychiatr.* 54 (10), 997–1006.
- Wang, J.F., Jiang, X., Bao, Z.J., Chen, J., 2019. The status of mental health and its influencing factors among medical postgraduates in Shanghai. *Chin. J. Health Educ.* 35 (6), 542–545.
- Wang, W.S., Shukla, P., Shi, G.C., 2021. Digitalized social support in the healthcare environment: effects of the types and sources of social support on psychological well-being. *Technol. Forecast. Soc. Change* 164.
- Wijeratne, C., Johnco, C., Draper, B., Earl, J.K., 2021. Older physicians' reporting of psychological distress, alcohol use, burnout and workplace stressors. *Am. J. Geriatr. Psychiatr.* 29 (5), 478–487.
- Windle, M., 1992. A Longitudinal study of stress buffering for adolescent problem behaviors. *Dev. Psychol.* 28, 522–530.

- Xia, F., Ye, B.J., 2014. The effect of stressful life events on adolescents' tobacco and alcohol use: the chain mediating effect of basic psychological needs and coping style. *J. Psychol. Sci.* 37 (6), 1385–1391.
- Xia, F., Ye, B.J., 2016. Parent-Child attachment and tobacco and alcohol use in adolescents: a mediated moderating model. *Chin. J. Clin. Psychol.* 25 (2), 382–385.
- Xiao, S., 1994. The theoretical base and research application of social support rating scale. *J. Clin. Psychiatr.* 2, 98–100.
- Xie, J.F., Liu, M., Zhong, Z.Q., Zhang, Q.X., Zhou, J.D., Wang, L., Ma, K.K., Ding, S.Q., Zhang, X.H., Sun, Q., Cheng, A.S.K., 2020. Relationships among character strengths, self-efficacy, social support, depression, and psychological well-being of hospital nurses. *Asian Nurs. Res.* 14 (3).
- Xin, Z.Q., Chi, L.P., 2001. The relationship between happiness and social support. *Acta Psychol. Sin.* 5, 442–447.
- Xing, Y.L., Wang, J.P., Wei, W., 2016. Perceived social support and anxiety in adolescents: the mediating of emotion regulation. *Chin. J. Clin. Psychol.* 24 (6), 1079–1082.
- Xiong, C.Q., Xu, Y.L., 2009. Reliability and validity of the stif action with life scale for Chinese demos. *China J. Health Psychol.* 17 (8), 948–949.
- Yan, B.B., Zheng, X., Zhang, X., 2011. Effects mechanism of social support on subjective well-being of college students-the mediating influence of self-control and depression. *J. Psychol. Sci.* 34 (2), 471–475.
- Yang, B., Xiong, C., Huang, J., 2021. Parental emotional neglect and left-behind children's externalizing problem behaviors: the mediating role of deviant peer affiliation and the moderating role of beliefs about adversity. *Child. Youth Serv. Rev.* 120.
- Ye, B.J., Li, D.P., Chen, Q.S., Wang, Y.H., 2011. Sensation seeking and tobacco and alcohol use among adolescents: a mediated moderation model. *Psychol. Dev. Educ.* 27 (4), 417–424.
- Ye, Y.M., Dai, X.Y., 2008. Development of social support scale for university students. *Chin. J. Clin. Psychol.* 5, 456–458.
- Yi, J., Ye, B.J., Liu, M.F., 2016. Affiliation with deviant peers and tobacco and alcohol use: the moderating of effortful control. *Chin. J. Clin. Psychol.* 24 (3), 544–546.
- Zhou, Y., 2016. Childhood trauma and subjective well-being in postgraduates: the mediating of coping style. *Chin. J. Clin. Psychol.* 24 (3), 509–513.
- Zhou, Z., Shek, D.T.L., Zhu, X., Li, Y., 2021. The influence of moral character attributes on adolescent life satisfaction: the mediating role of responsible behavior. *Child Indic. Res.* 14, 1293–1313.
- Zhu, X., Shek, D.T.L., 2020. The influence of adolescent problem behaviors on life satisfaction: parent-child subsystem qualities as mediators. *Child Indic. Res.* 13, 1767–1789.