



Research article

Relations between perceived social support and prosocial behavior among Chinese college students during online learning: Testing mediation and moderation models of meaning in life

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ABSTRACT

Base the protective role of perceived social support and meaning in life, the function of meaning in life as a mediator and moderator of perceived social support and prosocial behavior among Chinese college students enrolled in online learning was examined in this study. This survey was completed by 459 college students in total (Mean age = 19.65, SD = 1.21). The results shown that Chinese college students' perceived social support and prosocial behavior during online learning were significant lower than normal offline learning, but meaning in life was no significant difference. Perceived social support, prosocial behavior and meaning in life were all positive correlated with each other. The relationship between perceived social support and prosocial behavior was mediated and moderated by meaning in life. These findings enrich the research on prosocial behavior among college students by examining possible pathways linking factors associated to prosocial behavior during online learning. The findings suggest the need to promote prosocial behavior development through cultivate perceived social support and meaning in life among college students.

1. Introduction

The COVID-19 pandemic extended globally in 2020, while the World Health Organization classified pneumonia brought on by that illness as a “public health emergency of international concern” [1,2]. The Chinese government has instituted prevention and control policies to combat the pandemic, including home quarantine. These mandatory quarantines have triggered profound changes in people's lives [3]. Chinese college students are no exception, as most colleges have opted for an online learning model to coordinate the prevention and control policies [4]. In fact, in addition to the noticeable health-related effects, the pandemic poses a more severe threat to the psychological well-being of individuals and has led to significant behavior changes [5]. Existing research indicates that the level of prosocial behavior among college students was relatively low during the online learning period [6], likely due to insufficient perceived social support resulting from the isolation policies, which in turn affected the development of prosocial behavior. Although the quality of learning was assured through online learning, forcing college students to be separated from their classmates and teachers, they are in social isolation [7,8], and socially isolated people will report low levels of social support [9]. Low levels of perceived social support can lead to the emergence of various problematic behaviors, such as addictive behaviors [10,11], as well as

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detrimental to the development of positive behaviors, such as prosocial behavior [12]. Therefore, the first research objective of this study is to determine whether perceived social support influences prosocial behavior among Chinese college students during online learning.

Although online learning has enabled college students to maintain their physical health and quality of learning during the COVID-19 pandemic, the period of online learning have received less focus on college students' prosocial behavior and some psychological protection mechanisms during online learning. Meaning in life is one of the elements of the individual's cognitive system, which is thought to improve mental health, people facing adversity can reduce psychological stress by pursuing meaning in life [13]. The level of someone's appreciation and understanding of their existence is their meaning in life and the extent to which this is accompanied by a sense of their purpose and primary goal [14]. Studies have indicated that meaning in life facilitates adaptive coping and can promote growth and recovery [15]. In addition, according to previous research, people's meaning in life and prosocial behavior are positively correlated [16]. Thus, meaning in life may effectively alleviate the low level of perceived social support problems due to the social isolation arising from the online learning period, and benefit the prosocial behavior development among Chinese college students. Therefore, the second research objective of this study is to determine whether meaning in life mediates and moderates the relationship between perceived social support and prosocial behavior among Chinese college students during online learning. By investigating the potential mediating and moderating roles of meaning in life in this connection, the study also hoped to improved comprehension of the complex link between perceived social support and prosocial behavior.

2. Literature review

2.1. *The relationship between prosocial behavior and perceived social support among Chinese college students during online learning*

Prosocial behavior is defined as selfless action intended to assist another individual [17]. Even self-sacrificing for the benefit of others [18] contributes not only to individual life satisfaction but also to the harmonious development of society. Individual's prosocial behavior can be influenced by many factors, such as social support [19], resilience [20], life satisfaction [21], culture environment [22], and so on. To evaluate prosocial behavior more efficiently, researchers have developed many valid and reliable instruments for measuring prosocial behavior [23,24]. Based on these instruments, researchers have conducted numerous empirical studies on prosocial behavior. There is growing evidence that engaging in various forms of prosocial behavior can promote emotional well-being, which may result from the positive experiences, such as increased social connection and meaning [25–28]. Also, a study revealed that prosocial behavior may have a role to play in reducing the negative impacts of distress [29], and the level of prosocial behavior increases after a significant event [16,30]. For example, prosocial behaviors such as blood donation, donations, and resource sharing increased significantly during the outbreak compared to the period before the new crown outbreak [31]. However, some studies have also shown that adolescents' propensity for prosocial behavior during the online learning period caused by the COVID-19 pandemic is not high [32,33]. The existing contradictory findings suggest that prosocial behavior among Chinese college students during online learning may be influenced by multiple factors. Therefore, it is practically important to research the factors influencing prosocial behavior among Chinese college students during online learning.

The extent to which people experience and judge social support is known as perceived social support and responds to their satisfaction with having social acceptance and regard [34]. The influence of the environment on individual behavior is also described in the context of Bronfenbrenner's ecosystem theory [35]. Social support as an essential environmental factor can influence individual behavior. The social support buffering model states that those who perceived social support may be protected from the negative effects caused by external stimuli and prevent the development of undesirable psychology and behavior [36]. It has also been shown that social support in high-pressure environments can reduce adverse effects and act as a protective factor for prosocial behavior [37]. However, Chinese college students are socially isolated during online learning [38]. Studies have shown that socially isolated people will report low levels of social support [9]. In addition, during online learning period, virtual communication is used more often, and study shows that face-to-face communication is significantly more likely to elicit social support than virtual communication [39,40], combined with the fact that college students are socially isolated and report low levels of social support [9], suggests that throughout this time, college students had low perceptions of social support. Low levels of perceived social support can lead to the emergence of various problematic behaviors and detrimental to the development of prosocial behavior [12].

Previous research has shown that during normal offline learning periods, Chinese college students perceive a positive correlation between perceived social support and prosocial behavior [12]. During the online learning period caused by the pandemic, Chinese college students exhibit a lower propensity for prosocial behavior [6], and perceived social support levels do not seem to increase, and may even decrease due to social isolation [41]. This seems to support that during the online learning period caused by the pandemic, also a positive correlation between perceived social support and prosocial behavior.

2.2. *Meaning in life as mediator and moderator*

Meaning in life is believed to improve mental health and reduce psychological stress when facing adversity by pursuing it [13]. It is considered an element of the individual's cognitive system. Previous studies have shown that a sense of meaning in life effectively promotes adaptive coping and can foster growth and recovery [42]. During special periods like the pandemic, college students with a high level of meaning in life are also more likely to perceive social support [43]. Additionally, according to previous research, people's meaning in life and prosocial behavior are positively correlated [16,44]. Therefore, meaning in life may effectively alleviate the problems of low perceived social support due to social isolation during the online learning period and benefit the development of

prosocial behavior among Chinese college students.

Previous studies have mainly considered the influence of social support as a factor of environmental on behavior during normal offline learning periods [45,46], however, the particular phenomenon of perceived social support and prosocial behavior during online learning cannot be explained by previous research findings, so the underlying mechanisms should be explored. Bandura's social cognitive theory points out the influence of the external environmental system on the social cognitive system of the individual and discusses the influence of the individual's social cognitive system on their behavior [47]. In conjunction with ecosystem theory we can obtain the mediating model that environment (perceived social support) - individual cognition (meaning in life) - individual behavior (prosocial behavior), in this study, the cognitive system's ability to mediate perceived social support and prosocial behavior through the mediation variable of meaning in life will be examined.

As mentioned earlier, both perceptions of perceived social support and meaning in life effectively reduce the adverse effects of stress on individuals. Meaning in life not only reduces the effects of stress but also has a growth and recovery effect [15]. Combining the interaction of environment and individual cognition to influence individual behavior as discussed in ecosystem theory [35], that can reasonable to believe that the relationship between perceived social support and prosocial behavior is not only mediated by the meaning in life but also moderated by the meaning in life. According to the investigation, no prior research has examined the role that college students' meaning in life plays in influencing the link between perceived social support and prosocial behavior during online learning. Therefore, this study will fill this gap by exploring the mediating and moderating roles of meaning in life in the relationship between perceived social support and prosocial behavior among Chinese college students during the online learning caused by the pandemic. Fig. 1 shows the proposed theoretical model in this study and the specific research questions of this study are as follows.

- 1) Does perceived social support influence prosocial behavior among Chinese college students during online learning?
- 2) Does meaning in life mediating the link between perceived social support and prosocial behavior among Chinese college students during online learning?
- 3) Does meaning in life moderating the link between perceived social support and prosocial behavior among Chinese college students during online learning?

3. Method

3.1. Participants

Convenience sampling was employed to randomly select college students during the online learning period in universities from May to December 2022 as the study population. This study was approved by the Universiti Sains Malaysia and Baotou Medical College ethics committee, and did not involve any ethical issues. Students used WeChat to scan the code to obtain the questionnaire to completed online, all participating college students finished informed consent in the questionnaire to confirm their voluntary participation in the study and completed the questionnaire anonymously. A total of 459 valid questionnaires were collected. Among them (Mage = 19.65, SD = 1.21), 237 (51.6 %) male students and 222 (48.4 %) female students; 119 (25.9 %) were first year students, 90 (19.6 %) were secondly year students, 85 (18.5 %) were thirdly year students and 165 (36.0 %) were fourthly year students; 218 (47.5 %) were only children; 171 (37.3 %) were student leaders (Table 1).

Based on results calculated using G*Power 3.1 for a priori power analysis [48] indicated that to attain sufficient power (95 %) in identifying a medium effect size, a minimum of 107 individuals were required ($f^2 = 0.15$) for the mediation analysis and in order to acquire adequate power (95 %) to find a minor impact at $\alpha = 0.05$, a minimum of 89 individuals were needed for the moderation analysis [49]. So, with sample size $N = 459$, power was more than adequate for the research design.

3.2. Measures

3.2.1. Perceived social support

The Chinese Translation of the Multidimensional Scale of Perceived Social Support [50] (MSPSS) was administered to measure participants' level of perceived social support. The scale consisted of 12 items. It included three dimensions, include Family (4 items), Friends (4 items) and significant others (4 items). On a seven-point scale, participants gave each item a rating ranging from 1 (Very strongly disagree) to 7 (Very strongly agree), with higher scores indicating better perceived social support. In the Chinese college

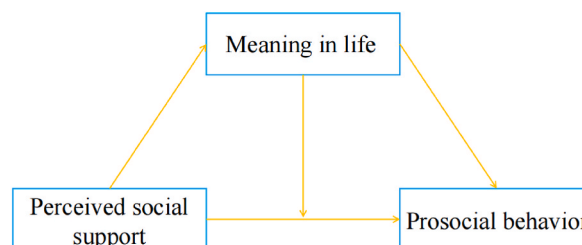


Fig. 1. Theoretical model.

Table 1
Distribution of participants.

Variables		N	Percent (%)
Gender	Male	237	51.6 %
	Female	222	48.4 %
Grade	First year	119	25.9 %
	Secondly year	90	19.6 %
	Thirdly year	85	18.5 %
	Fourthly year	165	36.0 %
Only child or not	Only child	218	47.5 %
	Non-only child	241	52.5 %
Student leader or not	Student leader	171	37.3 %
	Non-student leader	288	62.7 %

student population, this scale has been employed [51] and has demonstrated strong validity and reliability. The Cronbach's alpha coefficient used in this study was 0.93 for this scale.

3.2.2. Meaning in life

The Chinese Translation [52] of the Meaning in Life Questionnaire [53] (MLQ) was given to participants to gauge their meaning in life. The scale included 9 items and included two dimensions, presence (5 items) and search (4 items). Participants graded each item on a seven-point scale, with 1 being the most untrue (Absolutely Unture) and 7 being the most true (Absolutely True), with one reverse scoring question, and higher scores suggest high meaning in life. This scale has been widely used in Chinese college students [54,55] and has shown good reliability and validity. The Cronbach's alpha coefficient in this study was 0.858 for this scale.

3.2.3. Prosocial behavior

The Chinese Version of the Prosocial Tendencies Measure [56] (PTM) was used to gauge the prosocial behavior of the participants. The scale consisted of 23 items and included six dimensions, include compliant (2 items), emotional (4 items), altruism (5 items), anonymous (5 items), public (4 items) and dire (3 items). Each item was assessed by participants on a five-point scale, with 1 being the least accurate (Does not describe me at all) and 5 being the most accurate (Describes me greatly), with higher scores suggesting higher level prosocial behavior. This scale has been widely used in the Chinese college student population [57] and has shown very well reliability and validity. Cronbach's alpha for this scale in this study was 0.934.

3.3. Procedure

This study collected data from Chinese college students using a questionnaire consisting of well-established scales and demographic questions. The questionnaires were distributed through WeChat and participants completed them online. The final data obtained will be analyzed through a designed statistical analysis program.

3.4. Data analysis

As the data for this study are all from questionnaires, common method variance may occur and interfere with the actual results or conclusions, so the Harman's single-factor test is first used to examine common method variance initially [58]. Secondly, normality test was conducted to evaluate the normal distribution of the data based on Skewness and Kurtosis [59], with absolute values of Skewness less than 3, and absolute values of Kurtosis less than 10 indicating that the data did not serious violate the normal distribution [60,61]. Thirdly, through the SPSS25.0, descriptive statistics analysis were conducted to present the means and standard deviations for the study variables, use the one-sample *t*-test to examine the differences between the present study (online learning period) and previous study (offline learning period) in terms of perceived social support, prosocial behavior, and meaning in life [62]. Fourthly, to investigate the link between variables, Pearson's correlation analysis was performed. Fifthly, the link between perceived social support and prosocial behavior was examined using regression-based mediation analysis to see if meaning in life acted as a mediator. Finally, investigate how link between perceived social support and prosocial behavior are related to the moderating effect of meaning in life, PROCESS Model 1 was used to determine the relationship effect each other between meaning in life and perceived social support [63]. The models used 5000 resamples by bootstrapping confidence intervals to assess the significance of the effects in PROCESS Model 1 and all continuous study variables were standardized [64].

4. Result

4.1. Preliminary analysis

Harman's single-factor test findings revealed that after not rotating principal component factor analysis, a total of 22 factors had an Initial Eigenvalues than 1, and variance explained by the first factor was 31.27 %, which did not exceed the critical threshold of 40 %, so, in this study, there was no significant common method deviation. The results of the normality test are shown that the absolute

values of Skewness of perceived social support ($S = 0.07, K = -0.70$), meaning in life ($S = 0.22, K = -0.58$), and prosocial support ($S = 0.96, K = 0.81$) are all less than 3, and the absolute values of Kurtosis are all less than 10, indicating that the data normally in this study are acceptably.

The results of One-sample *t*-test shown that the mean score of perceived social support among Chinese college students in this study (60.60 ± 12.14) was significant lower than the previous study (64.92 ± 13.08) in 2019 ($t = -7.62, p < 0.001$) [65], the mean score of prosocial behavior among Chinese college students in this study (77.14 ± 13.85) was lower than the previous study (79.12 ± 12.88) in 2015 ($t = -3.06, p < 0.01$) [66], the mean score of meaning in life among Chinese college students in this study (44.59 ± 8.58) was no significant difference with the previous study (44.22 ± 7.55) in 2017 ($t = 0.91, p > 0.05$) [67].

The Pearson’s correlation results (Table 2) shown that perceived social support has a positive correlation with meaning in life ($r = 0.58, p < 0.01$) and a positive correlation with each dimensions and total of prosocial behavior (r ranged from 0.29 to 0.39, $p < 0.01$). Also, meaning in life has a great positively correlated with each dimensions and total of prosocial behavior (r ranged from 0.24 to 0.46, $p < 0.01$). To prevent the multicollinearity, variance inflation factors (VIF) were constructed, and the VIF value is 1.510, which is not higher than the upper limit of 5 [68]. So, the model has no problems with multicollinearity.

4.2. Mediating role of meaning in life

For the link between perceived social support and prosocial behavior, mediation analyses were carried out to examine the role that meaning in life plays as a mediator (Table 3 and Fig. 2). According to the procedure of testing mediating variables, regression analysis was conducted with perceived social support (Independent variable), meaning in life (Mediating variable), and prosocial behavior (Dependent variable). In the first step, the independent variable in the regression analysis was perceived social support and prosocial behavior as the dependent variable. In the second step, perceived social support was the independent variable, while meaning in life was the dependant variable in regression analysis. The third step involved doing regression analyses using prosocial behavior as the dependent variable and the independent variables are perceived social support and meaning in life.

Table 3 shows that the β coefficient of the effect of perceived social support on prosocial behavior was 0.39, indicating that prosocial behavior was significantly influenced by perceived social support. The β coefficient of perceived social support’s impact on a meaning in life was 0.58, indicating that meaning in life was significantly influenced by perceived social support. In addition, both β of perceived social support ($\beta = 0.23, p < 0.001$) and meaning in life ($\beta = 0.27, p < 0.001$) shows the significant effect on prosocial behavior, indicating that perceived social support and prosocial behavior are mediated by meaning in life to some extent, with the mediating effect accounting for approximately 40 % of the total effect size ($0.58 \times 0.27/0.39 \approx 0.40$).

4.3. Moderating role of meaning in life

Also, we looked at how meaning in life moderated the link between perceived social support and prosocial behavior. Prosocial behavior was proposed as the outcome variable, meaning in life as the subsequent moderator, and perceived social support as a predictor. The results (Table 4 and Fig. 3) show that the link between perceived social support and prosocial behavior was moderated by meaning in life. Prosocial behavior is significantly positively influenced by the combination of meaning in life and perceived social support ($F = 49.39, p < 0.05$). For the entire model, the adjusted R^2 was 0.25. Describe low, medium, and high levels of meaning in life individually for descriptive purposes (-1 SD, 0 SD, and 1 SD, respectively, shown in Fig. 4) of perceived social support on prosocial behavior was plotted. Analyses revealed that perceived social support has positively relationship with prosocial behavior for the middle ($b_{\text{simple}} = 0.24, t = 4.20, p < 0.001$) and high ($b_{\text{simple}} = 0.48, t = 6.83, p < 0.001$) levels of meaning in life, and perceived social support has no relationship with prosocial behavior in low ($b_{\text{simple}} = -0.002, t = -0.03, p = 0.98$) level of meaning in life. With the meaning in life’s level grows, the link between perceived social support and prosocial behavior will increase significantly.

5. Discussion

Using a sample of Chinese college students, the present study proposes a new mediation and moderation model to test whether

Table 2
Correlations between variables.

	M \pm SD	1	2	3	4	5	6	7	8	9
1	60.60 \pm 12.14	1								
2	44.59 \pm 8.58	0.58**	1							
3	6.70 \pm 1.57	0.31**	0.31**	1						
4	13.60 \pm 2.93	0.36**	0.36**	0.65**	1					
5	16.44 \pm 3.34	0.33**	0.32**	0.62**	0.76**	1				
6	17.06 \pm 3.77	0.31**	0.36**	0.57**	0.61**	0.62**	1			
7	12.70 \pm 2.81	0.29**	0.24**	0.59**	0.63**	0.75**	0.44**	1		
8	10.63 \pm 2.16	0.35**	0.46**	0.68**	0.72**	0.70**	0.62**	0.58**	1	
9	77.14 \pm 13.85	0.39**	0.41**	0.78**	0.87**	0.90**	0.80**	0.79**	0.84**	1

Note: N = 459; M = Mean, SD = Standard deviation; 1 = Perceived social support, 2 = Meaning in life, 3 = Compliant, 4 = Emotional, 5 = Altruism, 6 = Anonymous, 7 = Public, 8 = Dire, 9 = Prosocial behavior; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3
Mediation analyses of meaning in life.

Predictors	Step1		Step2		Step3	
	β	t	β	t	β	t
Perceived social support	0.39 ^a	8.97 ^a	0.58 ^a	15.27 ^a	0.23 ^a	4.43 ^a
Meaning in life					0.27 ^a	5.29 ^a
R ²	0.15		0.34		0.20	
F	80.38 ^a		233.29 ^a		56.52 ^a	

Note: N = 459. Step1 = perceived social support predicts prosocial behavior; Step2 = perceived social support predicts meaning in life; Step3 = perceived social support and meaning in life jointly predict prosocial behavior.

^a $p < 0.001$.

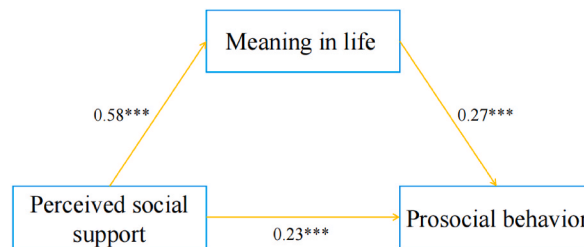


Fig. 2. Mediation model of meaning in life.

Table 4
Moderation analysis of meaning in life.

Predictors	Prosocial behavior				
	β	SE	t	95 % CI	
Perceived social support	0.24***	0.06	4.20***	[0.13, 0.35]	
Meaning in life	0.43***	0.08	5.26***	[0.27, 0.58]	
P × M	0.03***	0.01	5.32***	[0.02, 0.04]	
R ²	0.25				
F	49.39***				

Note: N = 459. *** $p < 0.001$; P = Perceived social support; M = Meaning in life. Same below.

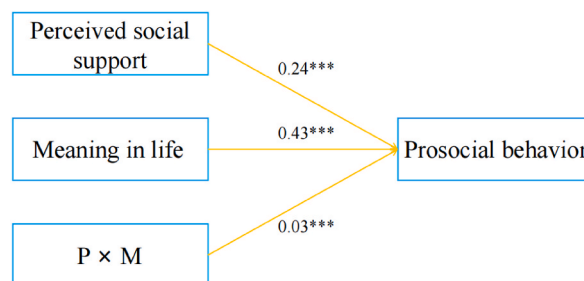


Fig. 3. Moderation model of meaning in life.

prosocial behavior among college students is highly influenced by perceived social support, as well as whether meaning in life mediates and moderates the relationship between perceived social support and prosocial behavior during the online learning period caused by COVID-19 pandemic. The internal relationship between college students' perceived social support and their prosocial behavior while taking online learning is being investigated for the first time in this study. Findings showed that Chinese college students' perceived social support had a great positive correlation with their prosocial behavior. In addition, the relationship between perceived social support and prosocial behavior was shown to be mediated and moderated by meaning in life. These findings have important value for protecting mental health, as well as promoting the development of prosocial behavior among college students during special periods.

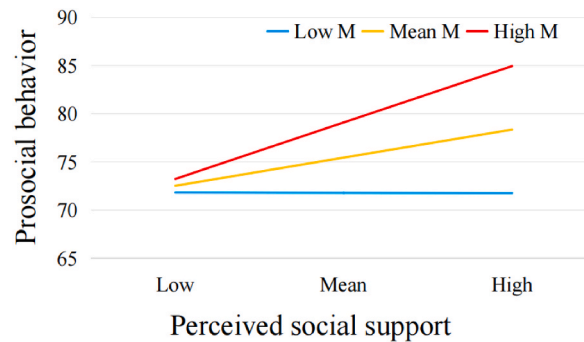


Fig. 4. Moderating role of meaning in life (M = Meaning in life).

5.1. The relationship between perceived social support and prosocial behavior among Chinese college student during online learning

The results of this study show that there is a significant positive correlation between perceived social support and prosocial behavior among Chinese college students during online learning caused by COVID-19 pandemic, consistent with findings from previous studies conducted during normal offline learning periods [12]. However, during the period of online learning, Chinese college students' levels of perceived social support and prosocial behavior are overall lower compared to normal offline learning periods [6, 69]. According to the social support buffering model [70], perceived social support can help individuals mitigate the effects of stress, thereby exhibiting more excellent prosocial behavior. Only when college students perceive sufficient social support are they likely to engage actively in social activities and exhibit more prosocial behavior [71]. Although online learning with a series of lockdown policies has curbed the spread of the pandemic and ensured the physical health of college students, it has led to significant social isolation [38]. Existing research indicates that socially isolated individuals report lower levels of social support [9], and low level of perceived social support will detrimental to the development of prosocial behavior [12]. Therefore, while the positive correlation between perceived social support and prosocial behavior among Chinese college students during online learning remains significant as during normal offline learning periods, the overall lower levels of both indicate the uniqueness of their positive correlation during this period.

5.2. Meaning in life mediates the relationship between perceived social support and prosocial behavior among Chinese college student during online learning

The results of this study contribute a new discovery that the positive correlation between Chinese college students' perceived social support and prosocial behavior is mediated by their meaning in life. Previous research have demonstrated a positive correlation between meaning in life and perceived social support [72]. In addition, previous research also found that a great level of meaning in life can promote the tendency of individuals to display prosocial behavior [16,73]. Consistent with previous findings, this study found that Chinese college students' perceived social support, meaning in life, and prosocial behavior were significantly correlated [72–74]. This proves that meaning in life and perceived social support are important internal protective elements that might improve prosocial behavior in stressful or demanding situations. The proposed mechanism for this relationship is that individuals who have higher levels of perceived social support are better able to appreciate the care of their parents, teachers, and friends and are better able to mitigate the psychological effects during online learning, that subsequently have happier lives and contribute to their meaning in life, they therefore have a greater propensity to practice prosocial behavior in order to benefit others and society.

5.3. Meaning in life moderates the relationship between perceived social support and prosocial behavior among Chinese college student during online learning

The results also showed that, between perceived social support and prosocial behavior, meaning in life plays a moderating effect. Therefore, the effect of perceived social support on prosocial behavior can be significantly enhanced at high levels of meaning in life. Previous studies have demonstrated that meaning in life facilitates adaptive coping and can promote growth and recovery [15]. Consistent with previous research findings, meaning in life can provide good psychological construction during online learning, thus protecting the psychological well-being of college students. Also, prior studies have demonstrated that stress may be moderated by a person's meaning in life [75]. Beyond these studies, the current research supports the role of meaning in life in protecting the relationship between perceived social support and prosocial behavior in online learning. A great degree of meaning in life is conceivable to protect individuals from suffering due to isolation during online learning, as it allows college students to experience active living and promotes perceived social support from all sources while also promoting prosocial behavior.

5.4. Implications

The current findings of this study guide improving college students' prosocial behavior during online learning. The results of this study indicate that during online learning, although the perceived social support and prosocial behavior of college students still show a positive correlation, the overall levels of both are lower compared to normal offline learning periods. Additionally, the relationship between perceived social support and prosocial behavior among college students during online learning is mediated by the meaning in life. The moderation model of meaning in life in the link between perceived social support and prosocial behavior was also demonstrated during online learning.

For practically, during the online learning period caused by COVID-19 pandemic, universities and the government should focus on college students' psychological well-being. In daily classes, it is recommended that college teachers actively interact with students to avoid a sense of spacing caused by too little or no communication between teachers and students. In addition, considering the isolation of college students during online learning, educators and administrators can actively guide students to feel the various support forces by adding mental health courses and leading them to build meaning in life, help students develop a great level of meaning in the life system, and improve their ability to cope with stress, as well as promote their prosocial behavior development.

5.5. Limitations and future directions

To the best of the author's knowledge, the present study is the first research to investigate the mediation and moderation effect of meaning in life on the relationship between perceived social support and prosocial behavior among college students during online learning. Using rigorous scientific methods, this study collected data from a sample of 459 Chinese college students, exploring the positive correlation between perceived social support and prosocial behavior during online learning, as well as the mediating and moderating roles of meaning in life in this relationship. However, the findings of this study have the following limitations.

Firstly, the present study used a cross-sectional design, which is insufficient to determine causality. Secondly, the sample in this study consisted entirely of Chinese college students, which may limit the generalizability of the findings due to regional or cultural differences. Finally, this study only examined the role of meaning in life in the relationship between perceived social support and prosocial behavior among college students during online learning. There may be other factors that influence this relationship, which were not explored in this study.

To fill the limitations of this study, firstly, future research could employ a longitudinal design to explore the causal relationship between perceived social support and prosocial behavior among college students during online learning. Secondly, future research could investigate the relationship between perceived social support and prosocial behavior among college students from different districts and cultures or conduct a meta-analysis to provide comprehensive evidence on whether these relationships and the mediating and moderating roles of meaning in life vary across regions and cultures. Lastly, it is recommended that future research build on the results of this study to explore other factors that may influence the relationship between perceived social support and prosocial behavior among college students.

6. Conclusion

This study found that during online learning, Chinese college students reported lower levels of perceived social support and prosocial behavior compared to normal offline learning periods. However, a significant positive correlation still existed between perceived social support and prosocial behavior among college students during online learning, and meaning in life played a mediating and moderating role in this relationship. These findings have important implications for interventions aimed at connecting perceived social support and prosocial behavior through psychological pathways during online learning. To promote the development of prosocial behavior among college students, it is essential to focus on their perceived social support and meaning in life. Additionally, during special periods such as online learning caused by the COVID-19 pandemic, college teachers and educators should pay attention to the perceived social support of students, increase interaction in the classroom, as well as foster meaning in life for college students.

Funding statement

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Data availability statement

Data in this study can be found online at <https://doi.org/10.7910/DVN/DYXT2E>.

Ethical statement

The study was conducted according to the Declaration of Helsinki, and approved by the ethics committee of Universiti Sains Malaysia (PIP22/MEDPSP/PMC500) and Baotou Medical College (March 30, 2022). All participants confirmed their voluntary participation in this study by completing the informed consent.

Informed consent form in questionnaire

Because the study population was Chinese college students, the informed consent form was in Chinese and placed before the questionnaire to confirm informed consent before entering to fill out the questionnaire. The following are both Chinese and English **Informed consent form**.

Chinese: 同学你好, 新冠疫情以来同学们都在线上上课的方式完成课程, 为了解我国大学生在在线学习期间的心里健康状况和为之之间的关系, 特开展此次研究。您将被邀请参加一项在线形式的问卷调查研究, 研究以匿名形式进行, 本调查中不涉及任何道德伦理问题, 同时本研究不针对个人做任何分析, 不会对个人有任何影响, 所有信息严格保密, 如果同意, 请选择同意, 并填写问卷。

English: Hello students, since the COVID-19 pandemic, students are completing their courses in an online format, this study is being conducted to understand the relationship between the mental health and behavior of our university students during their online studies. You will be invited to participate in a questionnaire study in an online format. The study will be conducted anonymously, there are no moral or ethical issues involved in this survey, also this study will not be analyzed for individuals and will not have any impact on them, all information is strictly confidential, if you agree, please choose to agree and fill in the questionnaire.

CRedit authorship contribution statement

Chunwei Lyu: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e37677>.

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