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# Associations between social support and proactive health behaviours among Chinese adolescents: the mediating role of self-efficacy and peer relationships

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## Abstract

**Background** Proactive health behaviours are crucial for enhancing adolescent health. However, there is limited evidence on the potential pathways through which social support influences adolescents' proactive health behaviours. This cross-sectional study aimed to examine the relationships between social support, self-efficacy, peer relationships and proactive health behaviours in Chinese adolescents.

**Methods** From October to December 2023, we recruited 6075 adolescents from Shandong Province, China. They completed self-report questionnaires on social support, self-efficacy, peer relationships and proactive health behaviours.

**Results** Linear regression analysis indicated that social support was positively associated with proactive health behaviours among adolescents ( $\beta=0.571$ , 95% CI = 0.542, 0.600). Further mediation analyses revealed that self-efficacy ( $\beta=0.085$ , 95% CI = 0.069, 0.101) and peer relationships ( $\beta=0.156$ , 95% CI = 0.136, 0.177) mediated this relationship.

**Conclusions** Increased social support was associated with better proactive health behaviours in Chinese adolescents. Additionally, higher self-efficacy and positive peer relationships enhanced this association. Our findings emphasised the significance of providing supportive environments at home and at school to promote proactive health behaviours in adolescents.

**Keywords** Social support, Self-efficacy, Peer relationships, Proactive health behaviours, Adolescents

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## Introduction

Adolescence is a crucial stage in life for establishing the foundations for good health [1]. Many primary risk factors for chronic noncommunicable diseases, such as substance misuse, dietary and exercise habits, and obesity, often emerge or develop during adolescence [2]. Globally, approximately 34.9% of adolescents exhibit three or more lifestyle risk factors, and approximately 90% of smokers begin smoking during this phase [3, 4]. A multicentre study of 9697 adolescents also indicated that 90.53% of adolescents had at least one health risk behaviour, and 54.32% had two or more health risk behaviours concurrently [5]. However, traditional lifestyle modification therapies often fail to provide meaningful and lasting changes for adolescents [6]. Therefore, research is needed to identify more proximal factors that are critical to promoting health behaviours. One such variable is motivation. Motivation and willingness are the decisive factors for the success of lifestyle change and may run through the entire process from adoption to maintenance [7]. During adolescence, there is an increase in autonomy and motivation in adolescents to monitor their own behaviour and lifestyle-related decisions, which is critical for health behaviour changes [8]. However, little is known about adolescents' motivation and ability to change their health behaviours. Therefore, investigating the motivation and ability of adolescents to proactively engage in health behaviours and their related factors is essential.

Proactive health behaviours refer to an individual's ability to proactively acquire health information and engage in health behaviours, which reflect their motivation and willingness to adopt and maintain good health. The concept of "proactive health" has been mentioned in previous studies, which emphasised the personal agency of individuals in self-health management [9]. Evidence suggests that health behaviour theories provide conceptual frameworks for health behaviour change, which is a better choice than traditional health education for achieving stable and permanent behavioural change in adolescents [10]. Several theories have been developed to explain the nature and role of motivation in various health behaviours. For example, the motivational components identified by self-determination theory and interventions based on this theory yield behaviour change initiation and long-term maintenance [11]. Recently, researchers have begun to apply social cognitive theory to promote health behaviour changes in adolescents and have achieved good results [10].

## Social cognitive theory

Social cognitive theory proposes that human behaviour, personal factors (e.g., self-efficacy), and environmental factors are mutually influencing, a process known as triadic reciprocal causation [12]. In this context,

environmental factors (e.g., social support and peer relationships) and personal factors (e.g., self-efficacy) may interact to motivate and regulate adolescents' behaviour [12–14]. Bandura describes personal agency as an individual's ability to achieve personal goals by proactively choosing and regulating his or her own behaviour [15]. Self-efficacy is a crucial component of personal factors, and it is essential for the exercise of personal agency and behavioural change [16]. Moreover, adolescence is characterised by the extension and modification of social groups and friendships [17]. Therefore, based on the social cognitive theory and previous studies, we aimed to identify the impact of social support on proactive health behaviours and explore the mediating effect of self-efficacy and peer relationships among Chinese adolescents.

## The influence of social support on proactive health behaviours

Social support refers to the support and motivation provided by important others, such as family members or peers [18]. Social support theory posits that social support is a combination of actual or perceived support that individuals receive when they are under stress or adapting to environmental changes [19]. The investigation of the correlation between social support and health behaviours has become a growing field in medicine in recent years [13]. An American study of high school students indicated that adolescents with more parental and peer support for physical activity were more physically active [20]. A qualitative study suggested that social support from family and friends played a crucial role in establishing and maintaining a healthy diet and physical activity [13]. Prior research has indicated that the social context is a precursor to optimal motivation [11]. Furthermore, more autonomous forms of motivation may emerge when psychological needs are met [11]. Another study also indicated that support from family and peers directly influenced the spontaneous adoption of health behaviours among adolescents [21]. Social support may provide adolescents with more resources and opportunities related to proactive health behaviours to overcome adversity in the future.

## The mediating role of self-efficacy

Self-efficacy refers to an individual's confidence in his or her capacity to accomplish specified goals [22]. Self-efficacy may be relevant in early motivational stages of behaviour change, which are directed towards the formation of an intention. When individuals are already motivated, self-efficacy gives them the confidence to implement their intentions and initiate and maintain behavioural changes in the volitional stages of the change process [23]. According to Bandura, individuals with higher self-efficacy are more likely to exhibit greater

motivation and resilience in adopting health behaviours [24]. A randomised controlled trial demonstrated a positive relationship between self-efficacy and health behaviours [25]. Another study of Hong Kong adolescents also suggested that improving adolescents' self-efficacy was an effective method for promoting oral health behaviours [14]. Health behaviours are sustained when individuals have confidence in their ability to achieve their desired goals. Furthermore, a meta-analysis suggested that social support improved adolescents' exercise self-efficacy and increased their confidence to engage in physical activity [26]. Therefore, it is reasonable to propose that social support is positively associated with adolescents' self-efficacy, which in turn affects their inclination to adopt proactive health behaviours. Therefore, we hypothesise that self-efficacy acts as a mediating factor between social support and proactive health behaviours in Chinese adolescents.

#### The mediating role of peer relationships

Peer relationships refer to interpersonal connections established and developed through communication and cooperation between individuals of similar age or psychological development levels [27]. After entering adolescence, adolescents often desire more autonomy and independence from their parents, and they place greater importance on peer relationships [28]. As a source of social support, positive peer relationships play a crucial role in the development of adolescent health behaviours. Previous studies showed that adolescents with positive peer relationships were more likely to participate in physical activity [29]. Conversely, a study of Chinese adolescents revealed that negative peer relationships were associated with an increased risk of adolescents becoming addicted to the internet or smartphones [27]. However, there is limited evidence on whether peer relationships influence individual motivations for health behaviours. Understanding the interplay of peer relationships and motivation can inform interventions to promote proactive health behaviours in adolescents. Furthermore, several studies indicated that support from

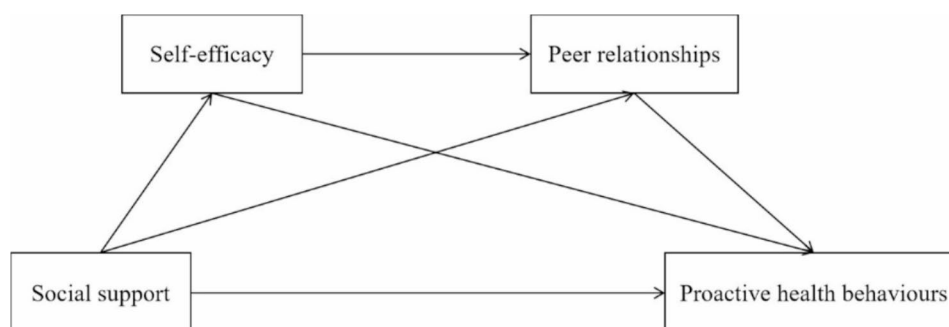
peers and family provided diverse social ties and mitigated the negative effects of peer victimisation [30, 31]. Therefore, peer relationships may be a mediator between social support and proactive health behaviours among adolescents.

#### The chain mediation effect of self-efficacy and peer relationships

Previous studies indicated that self-efficacy significantly influenced individuals' perceptions of their communication abilities and interpersonal relationships [32]. Individuals with high self-efficacy are better able to manage or avoid social stress and negative emotions. Furthermore, research suggests that individuals with high self-efficacy are more inclined to engage in prosocial behaviours, such as helping others and treating them kindly [33]. Nevertheless, most studies have focused on the influence of peer relationships on self-efficacy, and relatively little research has examined the impact of self-efficacy on peer relationships. Therefore, we deduced that support from family and peers may promote the development of high self-efficacy and positive peer relationships to increase the likelihood of adolescents adopting proactive health behaviours.

In addition, adolescent health behaviours are significantly influenced by sociodemographic characteristics. A study in China revealed that female adolescents from moderate family socioeconomic backgrounds were more prone to engage in unhealthy behaviours [34]. Furthermore, parental lifestyle behaviours significantly influenced offspring lifestyles. According to social cognitive theory, individuals learn from their own experiences and from observing and modelling the behaviour, attitudes, and outcomes of others. Wang et al. reported that offspring lifestyles were positively associated with maternal lifestyles [35].

Therefore, this study proposes three hypotheses, as shown in Fig. 1.



**Fig. 1** The chain mediation model and hypotheses

**H1** Self-efficacy serves as a mediator between social support and proactive health behaviours among Chinese adolescents.

**H2** Peer relationships serve as a mediator between social support and proactive health behaviours among Chinese adolescents.

**H3** Self-efficacy and peer relationships act as sequential mediators between social support and proactive health behaviours among Chinese adolescents.

## Methods

### Participants

This cross-sectional study was performed across the eastern (Yantai city), central (Zibo city), and western (Zaozhuang city) regions of Shandong Province, China. The social and economic characteristics of these three regions differ. The study was performed from October to December 2023. On the basis of the World Health Organization's (WHO) definition of adolescence [36], adolescents aged 11–19 years completed a self-assessment questionnaire independently at school. All participants were informed of the goal of the study and reassured that their information would be anonymous and confidential. Written informed consent from all participants or their parents or guardians was provided during the survey. Unqualified questionnaires and regularly answered questionnaires were excluded. Finally, a total of 6075 adolescents with complete survey data were recruited for this study. The Ethics Committee of Medical College of Qingdao University approved this study (QDU-HEC-2023226).

### Measurements

#### *Adolescent social support rating scale*

This scale was developed by Shuiyuan Xiao in 1986 and was adapted by Yuemei Ye in 2008 to measure social support [37, 38]. The 17-item scale consists of three dimensions: objective support, subjective support, and utilisation of support. The participants responded to each question on a 5-point rating scale (1=completely disagree, 5=completely agree). The total score of this scale ranged from 17 to 85. Higher scores indicate higher levels of social support. The scale has good consistency and validity in the Chinese population [39]. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.957.

#### *General self-efficacy scale*

The scale was developed by Schwarzer in 1997, and the Chinese version was translated and adapted by Caikang Wang in 2001 [40]. The scale has 10 items, with scores ranging from 1 ("not at all true") to 4 ("exactly true") for each item. The total score of the scale ranged from 10 to

40. Higher scores indicate a greater sense of self-efficacy. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.909.

#### *Peer relationships scale*

This scale was developed by Junfeng Wei in 2007 and is comprised of 18 items [41]. The scale contains three dimensions: intimacy, shared activities, and social anxiety. The participants responded to each question on a 5-point rating scale (1=Not true at all, 5=Completely true). The total score of this scale ranged from 18 to 90. A higher score indicates a stronger peer relationship. This scale has good consistency and validity among the Chinese population [27]. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.89.

#### *Proactive health behaviours scale*

This scale was developed to test the proactive health behaviours of adolescents in this study, referencing two articles [42, 43] (Table S1). This self-report questionnaire contains 24 items scored on a 5-point Likert scale ranging from 1 ("never") to 5 ("always"). The scale has five dimensions: health responsibility, exercise, diet, mental health, and self-discipline. The total score of the scale ranged from 24 to 120. Higher scores indicate higher levels of proactive health behaviours. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.949.

#### *Covariates*

The covariates included adolescents' region, age, gender, grade (junior school or high school), ethnicity (Han or minority), accommodation (boarding or non-boarding), BMI, family socioeconomic status, and healthy parental lifestyle. We calculated participants' BMI by dividing weight (kg) by height squared ( $m^2$ ). We then classified the data into three categories on the basis of Chinese age and sex-specific cut-off points: underweight or normal, overweight, and obese [44]. Among these three regions, Yantai city has the highest economic level and the largest population. To facilitate analysis, we transformed it into a dichotomous variable (Yantai city or other cities).

Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). This scale was developed by Radloff [45] and is comprised of 20 items, with 16 items measuring negative emotions and 4 items measuring positive emotions. The participants were asked to evaluate their mood over the past week by selecting one of four options: little or no (<1 day), not too many (1–2 days), sometimes half the time (3–4 days), or most of the time (5–7 days). Negative emotion responses were coded as 0, 1, 2, or 3, and positive emotion responses were coded as 3, 2, 1, or 0. These values were used to calculate an overall CES-D score ranging from 0 to 60. Higher scores indicate higher

levels of depression. This scale has good consistency and validity among adolescents [46]. A score of 16 was chosen as the cut-off point for indicating clinically significant depressive symptoms [47].

Family socioeconomic status was assessed by two indicators, parental education level and occupation [48]. Four items concerning family socioeconomic status were completed by the adolescents. Parental education levels were reported on a scale ranging from 1 (primary school and below) to 4 (college and above). The parents' occupations were classified into five groups, ranging from 1 (temporary workers) to 5 (senior managers and senior professionals and technicians). The raw scores of the two indices were converted into z scores then summed into composite points, with higher points indicating higher family socioeconomic status.

Healthy parental lifestyle factors included exercising regularly, current smoking status, and alcohol consumption. The smoking status was determined by asking respondents to report their parents' smoking status (yes or no). Alcohol consumption was assessed by asking participants whether their parents had consumed alcohol more than three times per week (yes or no). To assess parental exercise habits, participants were asked whether their parents exercised more than three times per week (yes or no).

#### Data analysis

STATA (Version 17.0) and IBM SPSS (Version 25.0) were used for all data analyses. The Kolmogorov–Smirnov test was used to assess the normality of continuous variables. Medians and interquartile ranges (Q1–Q3) were used to describe the skewed continuous variables. Frequencies and percentages were used to describe categorical variables. The Wilcoxon rank-sum (Mann–Whitney) and Kruskal–Wallis tests were used to assess differences in the demographic characteristics of proactive health behaviours. The proactive health behaviour score was used as the dependent variable and demographic characteristic, and the social support score was used as an independent variable. First, multivariable linear regressions were used to estimate the associations between the independent variables and the proactive health behaviour scores in the unadjusted models. Then, the independent variables that were significantly associated with proactive health behaviours ( $P < 0.05$ ) were included in the adjusted model. Second, Spearman correlation analyses were used to estimate the relationships between social support, self-efficacy, and proactive health behaviours. Third, the PROCESS macro v4.2 [Model 6] program was used to test whether self-efficacy and peer relationships mediated the associations of social support with proactive health behaviours. Demographic characteristics, including age, sex, accommodation, region, grade, BMI,

family socioeconomic status and parental healthy lifestyle, which can significantly affect the dependent variable, were included as control variables in the model. The 95% confidence interval (CI) of the mediation and moderation effects was estimated via 5000 bootstrapped samples. The effect was established when the 95% CI did not contain “0”.

To identify any differences in the results, we performed subgroup analyses according to sex, region, BMI category, and age group. Furthermore, to test the robustness of the findings, we re-analysed the association between social support and proactive health behaviours by excluding participants with depressive symptoms.

## Results

### Baseline characteristics of the participants

The baseline characteristics of the 6075 participants are presented in Table 1. In our study, 3462 participants (57.0%) were aged 11–15 years, and 3084 participants (50.8%) were girls. Nearly 53.0% of the participants were junior high school students. Mothers had a greater percentage of nonsmokers (98.1%) and nonhabitual drinkers (95.6%) compared to fathers. Adolescents who were female, in junior high school, aged 11–15 years, lived in Yantai city, with better family socioeconomic status and parents with healthy lifestyles had higher scores on proactive health behaviours. Obese and boarding adolescents had lower proactive health behaviour scores.

### Demographic and social support associated with proactive health behaviours

In the unadjusted model, social support, being from Yantai city, having higher family socioeconomic status, and having a healthy parental lifestyle were associated with higher levels of proactive health behaviours (Table 2). Age, boys, boarding at school, being in high school, overweight and obesity, and depression were associated with lower levels of proactive health behaviours.

In the adjusted model, the following factors were significantly associated with proactive health behaviours: social support ( $\beta = 0.571$ , 95% CI = 0.542, 0.600), boys ( $\beta = -9.516$ , 95% CI = -10.280, -8.752), Yantai city ( $\beta = 4.334$ , 95% CI = 3.583, 5.085), family socioeconomic status ( $\beta = 0.394$ , 95% CI = 0.278, 0.509), paternal nonsmoking ( $\beta = 1.210$ , 95% CI = 0.466, 1.954), paternal nonhabitual drinking ( $\beta = 1.317$ , 95% CI = 0.562, 2.073), paternal exercise regularly ( $\beta = 4.048$ , 95% CI = 3.229, 4.866), maternal exercise regularly ( $\beta = 2.943$ , 95% CI = 2.126, 3.761), obesity ( $\beta = -1.232$ , 95% CI = -2.176, -0.287), and depression ( $\beta = -5.107$ , 95% CI = -6.028, -4.186).

In the subgroup and sensitivity analyses, the associations of social support with proactive health behaviours remained significant (Tables S2–S5 in the Supplement). In the sex-specific analysis, there was a stronger relationship

**Table 1** Socio-demographic information of the participants (N=6075)

Variables	N (%)	Proactive health behaviors scores M(Q1-Q3)	Z/H	P
Age			7.190*	< 0.001
11–15	3462(57.0)	86(73–104)		
16–19	2613(43.0)	82(72–96)		
Sex			33.196*	< 0.001
Boys	2991(49.2)	78(70–87)		
Girls	3084(50.8)	98(76–115)		
Region			-10.908*	< 0.001
Yantai city	2064(34.0)	89(74–113)		
Other cities	4011(66.0)	82(72–97)		
Grade			7.697*	< 0.001
Junior school	3217(53.0)	87(74–105)		
High school	2858(47.0)	81(72–95)		
Accommodation			8.615*	< 0.001
Boarding	2018(33.2)	80(71–95)		
Non-boarding	4057(66.8)	86(74–103)		
BMI (kg/m <sup>2</sup> )			48.523 <sup>†</sup>	< 0.001
Underweight or normal	3904(64.3)	86(73–105)		
Overweight	1048(17.3)	83(73–96)		
Obesity	1123(18.5)	81(72–93)		
Family socioeconomic status			170.226 <sup>†</sup>	< 0.001
Bottom	1467(24.1)	79(70–94)		
Medium	2583(42.5)	83(73–97)		
Top	2025(33.3)	90(75–111)		
Depression			28.960*	< 0.001
Yes	1415(23.3)	73(64–82)		
No	4660(76.7)	89(76–109)		
Social support			1943.297 <sup>†</sup>	< 0.001
Bottom	1978(32.6)	73(64–81)		
Medium	2004(33.0)	84(74–94)		
Top	2093(34.5)	102(88–116)		
Self-efficacy			1012.247 <sup>†</sup>	< 0.001
Bottom	1720(28.3)	74(65–86)		
Medium	2020(33.3)	82(73–94)		
Top	2335(38.4)	95(81–115)		
Peer relationships			1536.518 <sup>†</sup>	< 0.001
Bottom	2000(32.9)	74(66–84)		
Medium	1985(32.7)	83(73–94)		
Top	2090(34.4)	99(86–116)		
Paternal healthy lifestyle				
Exercise regularly	3385(55.7)	91(76–112)	-23.284*	< 0.001
Nonhabitual drinking	3301(54.3)	89(74–110)	-13.398*	< 0.001
Nonsmoking	3053(50.3)	88(74–107)	-10.796*	< 0.001
Maternal healthy lifestyle				
Exercise regularly	3256(53.6)	91(76–112)	-22.536*	< 0.001
Nonhabitual drinking	5807(95.6)	85(73–100)	-7.084*	< 0.001
Nonsmoking	5960(98.1)	84(73–99)	-3.933*	< 0.001

The data are presented as medians and interquartile ranges (Q1–Q3) for continuous variables or n (%) for categorical variables

\*Z value. <sup>†</sup> H value

**Table 2** Association of social support with proactive health behaviors (N=6075)

	Unadjusted Model			Adjusted Model		
	$\beta$	95%CI	P	$\beta$	95%CI	P
Age	-1.197	-1.438,-0.955	<0.001	-0.314	-0.631,0.001	0.051
Boys	-16.924	-17.801,-16.048	<0.001	-9.516	-10.280,-8.752	<0.001
Boarding	-4.576	-5.602,-3.549	<0.001	-0.751	-1.571,0.069	0.073
Yantai	5.699	4.680,6.717	<0.001	4.334	3.583,5.085	<0.001
High school	-3.742	-4.713,-2.771	<0.001	-0.339	-1.623,0.944	0.604
Family socioeconomic status	1.064	0.915,1.214	<0.001	0.394	0.278,0.509	<0.001
Paternal healthy lifestyle						
Nonsmoking	5.269	4.304,6.234	<0.001	1.210	0.466,1.954	0.001
Nonhabitual drinking	6.732	5.769,7.695	<0.001	1.317	0.562,2.073	0.001
Exercise regularly	11.737	10.802,12.672	<0.001	4.048	3.229,4.866	<0.001
Maternal healthy lifestyle						
Nonsmoking	7.436	3.867,11.005	<0.001	-0.151	-2.837,2.534	0.912
Nonhabitual drinking	8.422	6.059,10.784	<0.001	0.656	-1.144,2.456	0.475
Exercise regularly	11.231	10.296,12.166	<0.001	2.943	2.126,3.761	<0.001
BMI (kg/m <sup>2</sup> )						
Overweight	-2.302	-3.617,-0.987	0.001	0.079	-0.872,1.031	0.869
Obesity	-4.536	-5.816,-3.256	<0.001	-1.232	-2.176,-0.287	0.011
Depression	-16.677	-17.750,-15.604	<0.001	-5.107	-6.028,-4.186	<0.001
Social support	0.821	0.793,0.850	<0.001	0.571	0.542,0.600	<0.001

Adjusted model was adjusted for age, sex, accommodation, region, grade, family socioeconomic status, parental healthy lifestyle, BMI, depression and social support

**Table 3** Bivariate correlation among social support, self-efficacy, peer relationships and proactive health behaviors (N=6075)

Variables	Mean $\pm$ SD	Min	Max	Correlation matrix			
				1	2	3	4
1.Social support	64.21 $\pm$ 13.87	17	85	1			
2.Self-efficacy	26.75 $\pm$ 5.99	10	40	0.48***	1		
3.Peer relationships	66.57 $\pm$ 12.79	21	90	0.64***	0.41***	1	
4.Proactive health behaviors	86.38 $\pm$ 19.36	25	119	0.61***	0.44***	0.54***	1

Note: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

between social support and proactive health behaviours in girls ( $\beta = 0.704$ , 95% CI=0.659, 0.750) compared to boys ( $\beta = 0.347$ , 95% CI=0.315, 0.379). We also found that the relationship between social support and proactive health behaviours was weaker in obese adolescents ( $\beta = 0.499$ , 95% CI=0.437, 0.562) compared to the other BMI groups ( $\beta = 0.591$ , 95% CI=0.554, 0.628). In the sensitivity analysis, after the exclusion of adolescents with depressive symptoms ( $n = 1415$ ), we found a stronger association between social support and proactive health behaviours ( $\beta = 0.575$ , 95% CI=0.542, 0.609) (Table S6 in the Supplement).

#### Bivariate correlations among social support, self-efficacy, and proactive health behaviours

Table 3 shows the correlations among the variables in this study. All four variables were significantly correlated. The results indicated that social support was positively related to self-efficacy ( $r = 0.48$ ,  $p < 0.001$ ), peer relationships ( $r = 0.64$ ,  $p < 0.001$ ) and proactive health behaviours ( $r = 0.61$ ,  $p < 0.001$ ). Self-efficacy positively correlated with peer relationships ( $r = 0.41$ ,  $p < 0.001$ ) and proactive

health behaviours ( $r = 0.44$ ,  $p < 0.001$ ), and peer relationships positively correlated with proactive health behaviours ( $r = 0.54$ ,  $p < 0.001$ ).

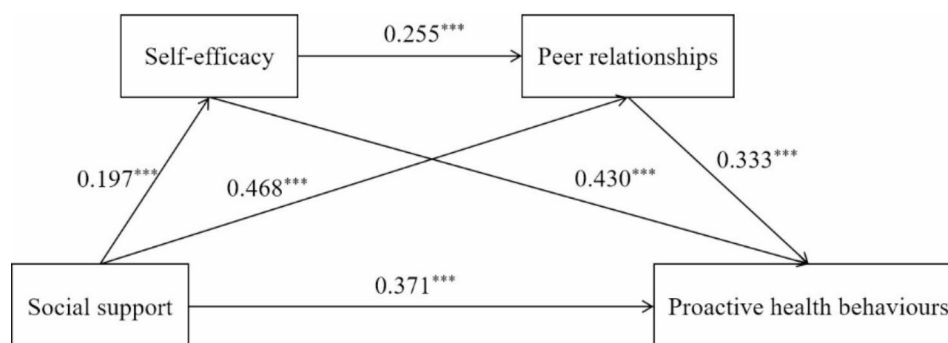
#### Mediation analyses of self-efficacy and peer relationships in the association of social support with proactive health behaviours

The results of the mediation analyses are summarised in Table 4; Fig. 2. After adjusting for potential confounding variables, the total effect of social support on proactive health behaviours was significant (total effect:  $\beta = 0.629$ , 95% CI=0.601, 0.656). The direct effects of social support on self-efficacy ( $\beta = 0.197$ , 95% CI=0.187, 0.207), peer relationships ( $\beta = 0.468$ , 95% CI=0.446, 0.489), and proactive health behaviours were significant ( $\beta = 0.371$ , 95% CI=0.338, 0.405). The direct effects of self-efficacy on peer relationships ( $\beta = 0.255$ , 95% CI=0.207, 0.304) and proactive health behaviours were significant ( $\beta = 0.430$ , 95% CI=0.364, 0.496). The direct effect of peer relationships on proactive health behaviours was also significant ( $\beta = 0.333$ , 95% CI=0.299, 0.367).

**Table 4** Mediating effects of self-efficacy and peer relationships on the relationship between social support and proactive health behaviors (N = 6075)

Total effect	$\beta$	SE	LLCI	ULCI
Social support→Proactive health behaviors	0.629	0.014	0.601	0.656
Direct relationships	$\beta$	SE	LLCI	ULCI
Social support→Self-efficacy	0.197	0.005	0.187	0.207
Social support→Peer relationships	0.468	0.011	0.446	0.489
Social support→Proactive health behaviors	0.371	0.017	0.338	0.405
Self-efficacy→Proactive health behaviors	0.430	0.034	0.364	0.496
Peer relationships→Proactive health behaviors	0.333	0.017	0.299	0.367
Self-efficacy→Peer relationships	0.255	0.025	0.207	0.304
Indirect relationships	$\beta$	Boot SE	Boot LLCI	Boot ULCI
Social support→Self-efficacy→Proactive health behaviors	0.085	0.008	0.069	0.101
Social support→Peer relationships→Proactive health behaviors	0.156	0.010	0.136	0.177
Social support→Self-efficacy→Peer relationships→Proactive health behaviors	0.017	0.002	0.013	0.021

Note: Bootstrap sample size=5000; CI confidence interval, SE standard error, LLCI lower limit confidence interval, ULCI upper limit confidence interval; This model adjusted for age, sex, accommodation, region, grade, family socioeconomic status, parental healthy lifestyle, BMI

**Fig. 2** Mediation analysis of self-efficacy and peer relationships in the relationship between social support and proactive health behaviours

Note: \* $P < 0.05$  \*\* $P < 0.01$  \*\*\* $P < 0.001$

We examined the potential mediating effect of self-efficacy and peer relationships on the association between social support and proactive health behaviours. The association was mediated by self-efficacy ( $\beta = 0.085$ , 95% CI = 0.069, 0.101) and peer relationships ( $\beta = 0.156$ , 95% CI = 0.136, 0.177). The indirect effects of self-efficacy and peer relationships on the association between social support and proactive health behaviours were also significant ( $\beta = 0.017$ , 95% CI = 0.013, 0.021). Furthermore, we performed all mediation analyses in subgroups, and the results remained significant (Table S7-S10 in the Supplement). In the sex-specific analysis, the mediating effect of peer relationships between social support and proactive health behaviours was more significant in girls ( $\beta = 0.244$ , 95% CI = 0.204, 0.285) compared with boys ( $\beta = 0.074$ , 95% CI = 0.057, 0.091).

## Discussion

This study investigated the association between social support and proactive health behaviours and assessed the mediating effect of self-efficacy and peer relationships on this association. We found that social support was positively associated with proactive health behaviours. Furthermore, self-efficacy and peer relationships partially mediated the association.

Several recent studies adopted various effective interventions (e.g., enhancing self-efficacy and health literacy) to promote health behaviour changes among adolescents. Some studies indicated that most interventions had limited effects that had diminished or vanished at long-term follow-up assessments [6, 49]. One possible explanation for this diminution may be that adolescents lack sufficient motivation and willingness to develop and sustain health behaviours. Adolescents lack a strong sense of health responsibility and depend more on outside sources to help them adopt and sustain health behaviours. Once an individual has established a routine of health behaviour



and has sufficient motivation to continue, it is possible to implement and sustain the behaviour [50]. Therefore, it is essential to improve adolescents' level of proactive health behaviour to maintain their long-term well-being.

### **Social support and proactive health behaviours**

Previous research considered social support a social-psychological mechanism that could affect an individual's mental and physical well-being [18]. According to the stress buffering hypothesis, it can also function as a buffer that protects individuals from adverse social influences [18, 51]. Our study found that social support was positively associated with proactive health behaviours. This finding is consistent with previous studies, which showed that low social support was significantly associated with unhealthy behaviours [52, 53]. Research on physical activity has also suggested that perceived social support was related to satisfaction in the areas of autonomy and competence [54]. Therefore, family and friends should provide wider social support for adolescents who exhibit lower levels of proactive health behaviours to increase their motivation and ability to engage in proactive health behaviours. Furthermore, we found a stronger association between social support and proactive health behaviours in girls compared to boys. This finding was also reported in other studies [55, 56]. A previous study suggested that girls were more empathetic and more able to perceive care from others [57]. Therefore, they had sufficient social resources to cope with adversity. In addition, obese adolescents had a weaker association between social support and proactive health behaviours compared to healthy peers. A review reported that obesity had a negative impact on their social functioning [58]. A previous study also revealed that obese adolescents were susceptible to being teased and rejected by their peers than normal adolescents [59]. Therefore, providing additional social support to special groups of adolescents may be an effective way of fostering proactive health behaviours.

### **The mediating role of self-efficacy**

We found that self-efficacy mediated the associations between social support and proactive health behaviours in adolescents. This finding was supported by several previous studies. A cross-sectional study among adolescents in Norway revealed a positive relationship between social support and self-efficacy [60]. A meta-analysis revealed that adolescents with higher levels of self-efficacy were more likely to engage in health behaviours [61]. Self-efficacy effectively promoted the initiation of behavioural changes, but these changes may not be sustained in the long term [25, 62]. Among the mechanisms of personal agency, none is more central or pervasive than people's beliefs about their ability to exercise control over events that affect their lives [15]. Adolescents' self-efficacy

beliefs determine their level of motivation, as reflected in how much effort they exert in proactive health behaviours and how long they persevere in the face of obstacles [50]. Therefore, it is imperative to provide consistent social support to maintain long-term self-efficacy and health behaviours. Adolescents can receive emotional and informational support via social networks, which can enhance their motivation and confidence to participate in proactive health behaviours.

### **The mediating role of peer relationships**

Our results revealed that peer relationships also mediated the association between social support and proactive health behaviours. This finding is consistent with a previous study, which indicated that a supportive family environment positively correlated with peer acceptance and reduced reactivity to peer rejection during adolescence [63]. A study of Chinese adolescents also demonstrated a negative association between peer relationships and smartphone addiction [64]. Hsieh YP et al. examined the relationship between peer victimisation and internet addiction and suggested that the occurrence of personal addictive behaviours was caused by unfulfilled interpersonal needs [65]. Zou et al. reported that adolescents who received positive feedback from peers were more able to spontaneously engage in long-term physical activity [66]. Therefore, positive relationships encouraged adolescents to proactively and consistently engage in proactive health behaviours. Conversely, negative peer relationships may contribute to the development and exacerbation of unhealthy behaviours. Furthermore, we discovered that the association between social support and proactive health behaviours was more significantly mediated by peer relationships among girls compared to boys. This finding was also reported in a previous study that reported significant gender differences in peer relationships and smartphone addiction [27]. Girls were more concerned with the opinions of peers, and they also feared abandonment, loneliness, and emotional harm [67].

### **The chaining mediating role of self-efficacy and peer relationships**

Our findings showed that social support promoted peer relationships, and the effect of social support was influenced by self-efficacy. A cross-sectional study of 733 adolescents demonstrated that positive parent-adolescent interactions resulted in increased levels of psychological capital (self-efficacy, optimism, hope, and resilience), which facilitated the development of positive peer relationships [68]. Adolescents who have high levels of social support are more likely to have high self-efficacy and strong peer relationships, which facilitates their engagement in proactive health behaviours. Most

studies focused on the mediating role of a single mediator between social support and health behaviours. This study explored the chain mediating role of self-efficacy and peer relationships in the association between social support and proactive health behaviours. People are more intrinsically motivated to adopt proactive health behaviours when they believe that they have options (e.g., autonomy), self-efficacy (e.g., competence), and that interpersonal needs are addressed [69]. According to social cognitive theory, there may be a positive, reciprocal relationship between high self-efficacy and positive peer relationships. Individuals with high self-efficacy are more likely to establish and maintain positive peer relationships, which in turn enhance self-efficacy. These findings provide further evidence of the mechanism by which social support influences proactive health behaviours.

Our results showed that some sociodemographic characteristics also significantly influenced adolescents' proactive health behaviours. We found that family socioeconomic status and regional economic differences significantly affected adolescents' proactive health behaviours. Specifically, adolescents living in developed regions and families with better socioeconomic status showed higher levels of proactive health behaviours. This finding is consistent with previous studies [70, 71]. Notably, this relationship was not limited to only environmental factors but also included genetic factors. We found that parental health behaviours significantly impacted offspring proactive health behaviours. This finding is consistent with previous studies, which also revealed a strong correlation between parental health behaviours and offspring health behaviours [72]. Additionally, our findings showed that mental health was also a significant predictor of proactive health behaviours in adolescents. Adolescents with depression exhibited lower levels of proactive health behaviours. This finding was consistent with previous studies that suggested a correlation between mental health problems and unhealthy lifestyles [73]. Adolescents with depressive symptoms have low motivation and energy for daily activities, which is significantly associated with unhealthy behaviours [73].

### Implications

Based on our findings, targeted interventions should encompass the reinforcement of social support networks, the enhancement of self-efficacy, and the guidance of positive peer relationship development. First, parents, educators and policy-makers should create a functional social support network and assist them in the identification and use of various social support sources. For example, parents should be encouraged to be autonomy supportive by encouraging adolescents' ability to make their own choices for their health behaviours. Second, our findings highlight the importance of enhancing

self-efficacy, which may be achieved through setting goals, observing others and receiving feedback from technologies (e.g., a fitness band or an app) to establish and maintain long-term self-efficacy. Third, educators and health care providers should facilitate the development of adolescents' social skills and help them develop positive peer relationships. Our findings also indicated that interventions targeting self-efficacy and peer relationships would be more effective in promoting proactive health behaviours among adolescents. Finally, in addition to focusing on behavioural changes, researchers should assess the level of adolescents' motivation and willingness to manage their health throughout the entire process. Notably, our results also indicated that individuals' proactive health behaviours were susceptible to depression. Therefore, researchers should give adequate attention to adolescents' proactive health behaviours at the psychological level.

### Strengths and limitations

Our study has the following strengths. First, this study is the first to examine the relationships between social support, self-efficacy, peer relationships and proactive health behaviours among adolescents. Second, we included a large sample of adolescents from three cities to ensure better representation. Third, we included more dimensional covariates, such as body mass index, depression, family socioeconomic status, parental health behaviours and regional economic differences. This inclusion allowed us to explore more factors that influenced proactive health behaviours. However, some limitations of this study should be noted. First, this study used a cross-sectional study design, which could restrict the ability to establish definitive directional relationships between the variables. The variables in the model, particularly social support, self-efficacy, and peer relationships, change over time. Therefore, longitudinal studies are essential to accurately monitor these fluctuations and their impact on proactive health behaviour. Second, this study used self-report surveys, which may lead to biased reporting and socially desirable responses. Therefore, more comprehensive questionnaires or objective quantitative methods should be used. Third, this study surveyed only adolescents, which may have biased the data on their families. Although we asked the participants to provide as much simple information about their family background as possible, we still found some possible confounding variables that could not be accurately measured. Therefore, further research should consider more confounding variables and include a more comprehensive range of social relationships among adolescents to ensure the accuracy of the results.

## Conclusion

This study demonstrated that social support promoted proactive health behaviours among adolescents. Moreover, the results also indicated that self-efficacy and peer relationships may serve as mediators in the association between social support and proactive health behaviours. To our knowledge, this study is the first to investigate the motivation and ability of adolescents to engage in proactive health behaviours. Future longitudinal studies are warranted to confirm the associations between social support, self-efficacy, peer relationships and proactive health behaviours. Therefore, these findings may guide families, schools, and governments to promote adolescent self-efficacy and peer relationships by providing social support to increase adolescents' autonomy and intrinsic motivation to engage in proactive health behaviours.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-20070-2>.

Supplementary Material 1

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## Author contributions

Zhiyuan Lu conceived of the study, participated in its design, performed the statistical analysis, and coordination and drafted the manuscript; Lianlong Yu and Kexin Fan participated in the design, performed the measurement, and interpretation of the data; Tian Hu and Lin Liu participated in the design and coordination of the study and performed the measurement; Suyun Li and Yunping Zhou conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

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## Data availability

The datasets created and analyzed during the present study are available from the corresponding author upon reasonable request.

## Declarations

### Ethics approval and consent to participate

The questionnaire and methodology for this study was approved by the Ethical committee of Medical College of Qingdao University (Ethics approval number: QDU-HEC- 2023226). Parents /guardians of all participating students provided informed consent and were informed about the study by the schools. If parents had any questions/concerns and/or did not want their child to participate, these students were not eligible to participate and did not receive the questionnaire.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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