scientific reports

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Canonical correlation-based relationships between social support and sleep quality in a hospital psychiatric outpatient population with examining the mediating roles of anxiety and depressive symptoms

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Objective: This study aims to examine the associations between various dimensions of social support and sleep quality in a hospital psychiatric outpatient population using canonical correlation analysis, while also investigating the potential mediating roles of anxiety and depressive symptoms. Methods: Employing a cross-sectional design, survey data were collected from 10,071 individuals visiting Hangzhou Seventh People's Hospital between October 2020 and October 2023. After excluding invalid cases, a total of 10,063 participants were included for analysis. The survey encompassed gathering basic demographic information as well as administering the Social Support Rating Scale, Self-rating Depression Scale, Self-rating Anxiety Scale, and Pittsburgh Sleep Quality Index Scale. Data analysis was conducted using SPSS 27.0 statistical software with canonical correlation analysis employed to examine the relationships. Additionally, the mediating effects of anxiety and depression symptoms were examined using the SPSS PROCESS macro. Results: Canonical correlation analysis reveals a significant positive correlation between social support dimensions and various aspects of sleep quality. The first pair of canonical variables ($r = 0.586$, $p < 0.001$) accounts for an impressive 97% of the cumulative contribution. It is found that this pair of canonical variables explains 68.9% of the variance in social support and 49.0% in sleep quality. Mediation analysis revealed that anxiety and depressive symptoms significantly mediated the relationship between social support and sleep quality, accounting for 88% of the total effect. Specifically, anxiety accounted for 47% mediation while depression accounted for 41%. Conclusion: The study findings revealed a significant positive correlation between social support and sleep quality dimensions, indicating a robust association between increased social support and enhanced individual sleep quality. Furthermore, the results indicated that anxiety and depression partially mediated the relationship between social support and sleep quality, offering novel insights into the intricate connection between mental health and sleep quality.

Keywords Sleep quality, Social support, Canonical correlation analysis, Mediation, Anxiety, Depression

Recently, the issue of sleep quality has been attracting increasing attention due to its profound impact on both individual well-being and the development of various chronic ailments[1,2]. Sleep quality is an important component

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of an individual's physical health, affecting cognitive function, emotional state, and physical recovery[3]. Research has shown that poor sleep is associated with a variety of mental health problems[4–6]. Maintaining low sleep quality over a long period of time may further impair people's mental health[7]. There is a growing recognition among individuals that sleep quality transcends personal concerns and is influenced by a multifaceted array of factors encompassing mental health, work-life balance, environmental conditions, and lifestyle behaviors[8]. Consequently, it becomes imperative to investigate the determinants[9], such as social support[10], physical activities[11], problematic smartphone use[12], that may influence sleep quality in order to advance public health initiatives and prevent associated diseases.

Social support refers to the resources and assistance individuals receive from their social networks, playing a crucial role in alleviating stress, promoting mental health, and enhancing overall quality of life[13]. It is recognized as a significant protective factor for individual psychological well-being, and consistently linked to sleep quality. The concept of social support encompasses the provision of emotional, informational, and practical assistance from one's social networks[14]. It is widely acknowledged as a crucial factor in effectively managing stress and enhancing mental well-being[15], particularly when confronted with life adversities and health-related challenges. A meta-analysis investigating the association between social support and sleep revealed a strong positive correlation between increased social support and improved sleep quality[10]. It supposed that social support can provide emotional comfort, channels for information exchange, and practical assistance, which helps alleviate the stress and challenges faced by individuals, and may thus have a positive impact on sleep quality.

However, despite the extensive investigation into the relationship between social support and sleep quality[10,16], there remains a dearth of research elucidating the underlying mechanisms of this association. Anxiety and depression are widely acknowledged as fundamental indicators of mental health disorders[17], exerting a direct impact on an individual's psychological well-being, while also potentially influencing the relationship between social support and sleep quality[18–22], this suggests their crucial role in mediating this association.

On the other hand, it is important to note that social support and sleep quality are complex constructs encompassing multiple subvariables and dimensions[23–25]. The relationship between them is not simply a direct or indirect effect but involves intricate interactions and potential mediating variables. While some studies have explored the impact of social support on sleep quality, most of these investigations have relied on simple correlation analysis or multiple linear regression analysis. Simple correlation analysis primarily captures the linear association between two variables, failing to capture non-linear relationships and considering only isolated associations between individual variables without accounting for interconnections among subvariables within the variable group[26].

Our study aims to address this research gap by employing canonical correlation analysis (CCA) methods to investigate the association between social support and sleep quality in a hospital outpatient population, while also examining the potential mediating role of anxiety and depression in this relationship. CCA is a powerful multivariate statistical technique that explores the relationships between two sets of variables[27]. Unlike traditional regression or path analysis, which focus on examining the impact of individual predictors on outcomes, CCA identifies the underlying linear combinations of variables within each set that exhibit the highest possible correlation with each other, given both social support and sleep quality are multidimensional constructs, it allows us to analyze the complex interplay between multiple dimensions of social support and sleep quality simultaneously, rather than in isolation.

We hypothesize that a positive canonical correlation exists between dimensions of social support and sleep quality, with anxiety and depression serving as partial mediators in the relationship between social support and sleep quality. This implies that while social support directly impacts sleep quality, anxiety and depression also function as mediating variables to partially elucidate this effect. Through a comprehensive analysis of these variables' interactions, we aim to provide a more nuanced understanding for enhancing individuals' sleep quality.

Methods

Participants and procedure

All individuals who had outpatient appointments scheduled at Hangzhou Seventh Hospital between October 2020 and October 2023 were invited to participate in this study. After their arrival, the investigators provided them with comprehensive face-to-face explanations regarding the study's objectives and implications, ensuring their eligibility for participation and informed consent was obtained from each individual before distributing questionnaires. The survey was administered using electronic tablets, and participants independently completed the questionnaires; however, trained investigators provided assistance to any participants who were unable to do so. This survey required approximately 30 min for completion, and no financial incentives were offered to participants in exchange for their participation in this research.

The survey included gathering essential demographic data along with administering various standardized scales such as the Social Support Rating Scale (SSRS), Self-rating Depression Scale (SDS), Self-rating Anxiety Scale (SAS), and Pittsburgh Sleep Quality Index Scale (PSQI).

The inclusion criteria were as follows: (i) no severe problems with vision, hearing, or speaking reported by the individual or observed by the investigators; (ii) willing to give written informed consent.

In total, 13,401 individuals were accessed, with 3,330 declining participation and 10,071 successfully completing the survey. Invalid cases were defined as questionnaires that were not completely filled out for PSQI, SSRS, SAS, and SDS. All such cases were excluded from the final analysis to ensure the integrity and validity of the data and results. After excluding eight invalid cases, a final sample of 10,063 participants was included for analysis. The research was performed in accordance with the Declaration of Helsinki, and approved by the Research Ethics Committee of the Department of Psychology and Behavioral Sciences, Zhejiang University (No. 2020-059). Written informed consent was obtained from all the participants.

Measurement

Sleep quality

Sleep quality was measured using the Chinese version of the Pitts-burgh Sleep Quality Index (PSQI)[28]. The PSQI is a self-report questionnaire that evaluates sleep patterns over the past month. In terms of structure and scoring, the Chinese version of PSQI remained consistent with the original version developed by Buysse et al.[29]. It consists of 18 items that are subdivided into seven dimensions: sleep duration, sleep latency, habitual sleep efficiency, sleep disorder, subjective sleep quality, use of sleeping pills and diurnal dysfunction. Each item is rated on a scale ranging from 0 to 3, where higher scores indicate greater difficulty. A global score greater than 5 (range 0–21) indicates poor sleep quality, with higher scores indicating worse sleep quality. The Chinese version of the PSQI has been shown to have good validity and reliability, with a Cronbach's alpha coefficient ranging from 0.82 to 0.83[28]. The PSQI exhibited excellent reliability in this study, with a Cronbach's alpha coefficient of 0.84, and demonstrated strong validity as evidenced by a KMO measure of 0.88 ($p < 0.001$).

Anxiety and depression symptoms

Anxiety symptoms were evaluated using the Self-Assessment Scale for Anxiety (SAS). It was developed by Zung in 1971[30], consists of 20 items rated on a 4-point scale ranging from 1 (not present or rarely present) to 4 (present most or all of the time), reflecting the frequency of anxiety symptoms. In this study, SAS showed a Cronbach's alpha of 0.93 and a KMO of 0.96 ($p < 0.001$).

The Self-Depression Scale (SDS)[31] was utilized to evaluate the depressive symptoms. This scale comprises 20 items and is assessed on a 4-point Likert scale, with responses ranging from 1 (rarely) to 4 (the vast majority of the time). A higher score on this scale indicates a greater severity of depression. In this study, SDS exhibited high reliability with a Cronbach's alpha of 0.92 and acceptable construct validity with a KMO of 0.97 ($p < 0.001$).

Social support

The Social Support Rating Scale (SSRS) developed by Xiao[32] was employed to evaluate the participants' social support. This scale comprises three dimensions encompassing a total of 10 items, including subjective support (Items 1, 3, 4, and 5), objective support (Items 2, 6, and 7), and support utilization (Items 8, 9, and 10). The SSRS total score ranges from12 to 66, with higher scores indicate greater levels of social support. Extensively utilized in the Chinese population, the SSRS has demonstrated good internal consistency with a Cronbach's alpha coefficient ranging from 0.71 to 0.87[33,34]. In this study, the Cronbach's alpha coefficient of the SSRS was 0.85, and the KMO was 0.88 ($p < 0.001$).

Statistical analysis

The present study employs descriptive statistical methods to analyze fundamental demographic information. Before conducting the formal analysis, Kolmogorov-Smirnov (K-S) tests were performed to evaluate the distribution of variables. The findings indicate that all variables adhere to a normal distribution, with p-values > 0.05. CCA is utilized to examine the association between different dimensions of social support and sleep quality. The handling, description, and analysis of the corresponding samples are all conducted using SPSS 27.0 software.

Canonical Correlation Analysis is a multivariate technique that assesses correlations across two variable sets[35]. It achieves this by reducing the dimensionality of the original data, extracting two integrated random variables called canonical variables. These canonical variables represent the original sets and their correlation reflects the relationship between them. The first set of variables is denoted as $X = (X_1, .. X_p)$, while the second set is denoted as $Y = (Y_1, .., Y_q)$. Canonical correlation analysis extracted canonical components U from the first set of variables X via principal component analysis (U was a linear combination of $X_1, .. X_p$). The canonical components V were then extracted from the second set of variables Y (V was a linear combination of $Y_1, .., Y_q$) while maximizing the correlation between U and V. This U–V correlation reflected the correlation between the two sets of variables X and Y[36].

In the present study, the scores on the three dimensions–subjective support, objective support, support utilization (defined as $X_1 \sim X_3$) of the SSRS were utilized as canonical variables U, while the seven dimensions–sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disruptions, hypnotic use, daytime dysfunction (defined as $Y_1 \sim Y_7$) of the PSQI were employed as canonical variables V.

Mediation analysis was performed via SPSS PROCESS macro (Model 4), which was developed by Preacher and Hayes[37]. The mediation analysis satisfied the key statistical assumptions, including linearity, homoscedasticity, absence of multivariate outliers, normality of residuals, independence, and collinearity diagnostics as indicated by the SPSS outputs. These findings establish a robust foundation for further investigation into the mediation effects. Prior to the analysis, social support, anxiety symptoms, depression symptoms, and sleep quality were all standardized. Additionally, we performed analyses with and without control variables to demonstrate their impact on the relationship between social support and sleep quality. Furthermore, bootstrapping with 5000 resamples was employed to calculate 95% confidence intervals (CIs) for assessing the indirect effect of each variable. If the 95% CI did not include zero, it indicated a significant indirect effect[38]. Statistical significance was determined at $p < 0.05$ (two-tailed).

Results

Testing common method bias

Given that the data for this study was obtained through a questionnaire, it is possible that common method bias exists among different variables. To address this concern in survey research, we conducted Harman's single-factor test to assess the potential impact of common method bias on the study results. In total, six factors with eigenvalues greater than 1 were extracted, explaining 55.2% of the total variance. The first principal factor

Variables		Sleep conditions		$\chi 2$	*p*
		Without sleep disorder	With sleep disorder		
Gender				77.9	< 0.001
	Male	1595	1770		
	Female	2560	4138		
Age				79.6	< 0.001
	0–17	1506	1911		
	18–65	2624	3823		
	>65	25	174		

Table 1. Demographic characteristics.

Canonical pairs	Correlation coefficient	Eigenvalue	Cumulative proportion%	Wilk's	Approximate F value	*P*-value
1	0.586	0.523	97.212	0.647	225.088	0.000
2	0.115	0.013	99.628	0.985	12.489	0.000
3	0.040	0.002	100.00	0.998	3.298	0.006

Table 2. Canonical correlation coefficients between social support and sleep quality.

accounted for 37.7% of the variance, which falls below the critical threshold of 40%[39], indicating effective control over common method bias.

Demographic characteristics

The demographic characteristics of the participants were presented in Table 1. Based on their PSQI scores, the participants' sleep conditions were classified into two groups: without sleep disorder group (scores ≤ 7) and sleep disorder group (scores > 7). The chi-square test results revealed a significant gender difference in the prevalence of sleep disorders ($\chi 2 = 77.9$, $p < 0.001$). Participants were stratified into three age groups: 0–17 years, 18–65 years, and above 65 years. A notable variation was observed in the occurrence of sleep disorders across different age groups ($\chi 2 = 79.6$, $p < 0\ 0.001$).

Canonical correlation between social support and sleep quality

Significance test of canonical correlation coefficients

The canonical correlation analysis was performed to examine the relationship between the typical variables of social support (u) and sleep quality (v). The results are presented in Table 2. The analysis revealed a significant positive correlation ($r = 0.586$, $p < 0.001$) between the first pair of typical variables, indicating a strong association between these two sets of variables. Furthermore, this initial pair accounted for 97% of the shared variance, suggesting that it adequately explains the common variability among the variables. Consequently, we focused solely on this primary relationship in subsequent analyses to simplify the model.

Standardized canonical coefficients for canonical variables

The magnitude of the absolute value of the standardized coefficients in the canonical correlation analysis represents the magnitude of the weights. As indicated by the standardized first.

canonical correlation coefficients (see Table 3), for the first canonical variate (U1), the standardized canonical coefficients of Support utilization, Subjective support, Objective support, as the variables of social support, were − 0.477, -0.489 and − 0.211, respectively. The coefficients of Support utilization (− 0.477) and Subjective support (− 0.489) contributed the most to social support.

For the first canonical variate (V1), were the variables of sleep quality, and the standardized canonical coefficients were 0.224, 0.198, 0.072, 0.100, 0.238, 0.238, -0.064 and 0.452, respectively. In particular, daytime dysfunction (Y7) had the most significant positive contribution to V1, with a coefficient value of 0.452, indicating that increased daytime dysfunction had a strong positive correlation with increased V1. This finding suggests that daytime dysfunction may be a key indicator of decreased sleep quality. In addition, Subjective sleep quality (Y1) and sleep disruption (Y5) also showed positive contributions to V1, although their coefficients were relatively small(0.224 and 0.238).The two formulas presented below were derived from the canonical correlation analysis.

These equations are as follows:

$$U1 = -0.477 \times 1 - 0.489 \times 2 - 0.211 \times 3 \quad (1)$$

$$V1 = 0.224Y1 + 0.198Y2 + 0.072Y3 + 0.100Y4 + 0.238Y5 - 0.064Y6 + 0.452Y7 \quad (2)$$

Canonical loadings and cross loadings

Due to the high potential for correlation and covariance between the dimensions of social support and sleep quality, it is insufficient to explain the issue solely through canonical weights. To better reflect the relationship

Social support variable set		Sleep quality variable set	
Variables	U_1	Variables	V_1
Support utilization (X_1)	-0.477	Subjective sleep quality (Y_1)	0.224
Subjective support (X_2)	-0.489	Sleep latency (Y_2)	0.198
Objective support (X_3)	-0.211	Sleep duration (Y_3)	0.072
		Sleep efficiency (Y_4)	0.100
		Sleep disruptions (Y5)	0.238
		Hypnotic use (Y6)	-0.064
		Daytime dysfunction (Y7)	0.452

Table 3. Coefficients of standardized canonical variables for social support and sleep quality.

variable set	Variable	Canonical Loading	Cross-Loading
Social support (U_1)	Support Utilization(X_1)	-0.867	-0.508
	Subjective Support(X_2)	-0.886	-0.519
	Objective Support(X_3)	-0.728	-0.427
Sleep quality (V_1)	Subjective Sleep quality(Y_1)	0.830	0.486
	Sleep latency(Y_2)	0.757	0.443
	Sleep duration(Y_3)	0.630	0.369
	Sleep efficiency(Y_4)	0.587	0.344
	Sleep disruptions(Y_5)	0.808	0.473
	Hypnotic use(Y_6)	0.234	0.137
	Daytime dysfunction(Y_7)	0.848	0.497

Table 4. The loadings and cross loadings of the variables for the first canonical function in canonical correlation analysis. Note: Absolute values greater than 0.35 are considered to indicate strong correlations.

between the original variables and the canonical variables, further analysis of their interrelationships is required through canonical loadings and cross-loadings[35]. The results for typical loads and cross loads are presented in Table 4.

In the canonical correlation analysis between social support (U) and sleep quality (V), the first canonical variable for social support (U_1) shows that subjective support (X_2) has the highest canonical loading coefficient (-0.886), followed by support utilization (X_1, -0.867) and objective support (X_3, -0.728). This indicates that subjective support is the most significant factor in explaining the relationship between social support and sleep quality, suggesting that when individuals feel more emotional support and understanding, their sleep quality tends to improve.

For the sleep quality canonical variable (V_1), the loadings reflect the importance of each dimension in explaining overall sleep quality (V_1). Daytime dysfunction (Y_7) has the highest loading coefficient (0.848), highlighting the significant impact of sleep quality on daily functioning. Subjective sleep quality (Y_1, 0.830) follows closely, indicating that an individual's self-assessment of their sleep quality is a crucial factor in the overall evaluation of sleep quality. Sleep disruptions (Y_5, 0.808) also show a strong loading, suggesting that frequent sleep interruptions are a key factor influencing sleep quality.

Other dimensions such as sleep latency (Y_2, 0.757), sleep duration (Y_3, 0.630), and sleep efficiency (Y_4, 0.587) also significantly impact sleep quality, although their influence is relatively lower. The use of hypnotic medication (Y_6, 0.234), while having a lower loading, still reflects its role in the overall sleep quality assessment.

Cross-loading analysis further elucidates the specific relationships between social support and sleep quality. For the social support variable set (U_1), support utilization (X_1, -0.508) and subjective support (X_2, -0.519) play key roles in the overall impact of social support on sleep quality. This suggests that how individuals use support resources in real life and the extent of support they perceive significantly influence their sleep quality.

In the sleep quality variable set (V_1), daytime dysfunction (Y_7, 0.497) and subjective sleep quality (Y_1, 0.486) still exhibit high cross-loadings, underscoring their importance in the overall assessment of sleep quality. The high cross-loading values indicate that social support not only improves individuals' subjective sleep quality but also reduces daytime dysfunction, thereby positively influencing sleep quality.

Step	DV	IV	*R*	*R*-sq	F	β
1	PSQI	SSRS	0.547	0.299	1430.686***	-0.524
2	SAS	SSRS	0.580	0.336	169.945***	-0.569
3	SDS	SSRS	0.668	0.447	2704.937***	-0.659
4	PSQI	SSRS	0.790	0.623	3330.517***	-0.061
		SAS				0.433
		SDS				0.328

Table 5. Mediation analysis of anxiety and depressive symptoms between social support and sleep quality. Note: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, Abbreviations: DV, Dependent Variable; IV, Independent Variable; PSQI, Pittsburgh Sleep Quality Index; SAS, Self-rating Anxiety Scale; SDS, Self-rating Depression Scale; SSRS, Social Support Rating Scale.

Effect Relationship	Effect	LLCI	ULCI	Effect Proportion
Total Effect	-0.287	-0.296	-0.278	
Direct Effect	-0.034	-0.042	-0.025	12%
Indirect Effect	-0.253	-0.262	-0.245	88%
Indirect SAS	-0.135	-0.263	-0.230	47%
Indirect SDS	-0.118	-0.237	-0.195	41%

Table 6. Bootstrap results of the mediation analysis. Abbreviations: SAS, Self-rating Anxiety Scale; SDS, Self-rating Depression Scale. Abbreviations: X, Social support; Y, Sleep quality; M_1, Anxiety; M_2, Depression; SSRS, Social Support Rating Scale; PSQI, Pittsburgh Sleep Quality Index Scale; SAS, The Self-Assessment Scale for Anxiety; SDS, The Self-Depression Scale.

Redundancy analysis

The results of the typical redundancy analysis showed that the first typical redundancy for the set of social support variables was 0.689 and the second typical redundancy was 0.237, which indicates that the cumulative percentage of the variance in social support explained by its own typical variables was 68.9%. In contrast, the cumulative percentage of differences in sleep quality explained by the typical variables of the social support variable set was 23.7%. Similarly, the cumulative percentage of differences in sleep quality explained by the typical variable of sleep quality itself was 49.0%, while the cumulative percentage of differences in social support explained by the paired typical variable of the sleep quality set was 16.8%. This suggests that social support and sleep quality can be explained not only by their own typical variables, but also by each other's typical variables, suggesting that there is an interaction between these two domains.

Mediation effects of anxiety and depressive symptoms

The mediation analysis, as presented in Table 5, has underscored the critical roles of anxiety and depression in the dynamic relationship between social support and sleep quality. Initially, Model 1 revealed a robust total effect, demonstrating a significant negative correlation between scores on the SSRS and PSQI, with a standardized beta coefficient (β) of -0.524. This correlation suggests that an increase in social support is indicative of improved sleep quality ($p < 0.001$).

The integration of anxiety (SAS) and depression (SDS) as mediators into the analysis yielded significant negative β coefficients of -0.569 and −0.659, respectively. These results indicate that higher levels of social support are associated with decreased levels of anxiety and depression, which are, in turn, positively linked to higher PSQI scores. When anxiety and depression were included in the final model (Model 4), the direct effect of social support on sleep quality was substantially weakened to (β=-0.061), highlighting the significant mediating roles these psychological factors exert within the context of social support and sleep quality.

Table 6, which showcases the bootstrap analysis results, offers a deeper understanding of the mediation effects. The total effect of social support on sleep quality was found to be significant, with an effect size of -0.287 and a 95% confidence interval ranging from −0.296 to -0.278, excluding zero[40]. This finding points to a strong overall influence of social support on sleep quality.

After adjusting for anxiety and depression, the direct effect of social support on sleep quality was notably reduced, accounting for only 12% of the total effect with a β of -0.034. The indirect effects through anxiety and depression were considerable, mediating 47% and 41% of the total effect, respectively. The effect sizes for these indirect effects were −0.135 for anxiety and −0.118 for depression, underscoring the influential role these mediators play in the relationship between social support and sleep quality.

Figure 1 visually consolidates these pathways, illustrating the negative associations from SSRS to SAS and SDS, and the positive associations from SAS and SDS to PSQI. The reduction in the direct effect from SSRS to PSQI, from the initial total effect (c = -0.524) to the direct effect after considering the mediators (c' = -0.061), confirms the mediating roles of anxiety and depression. This attenuation of the direct effect further validates

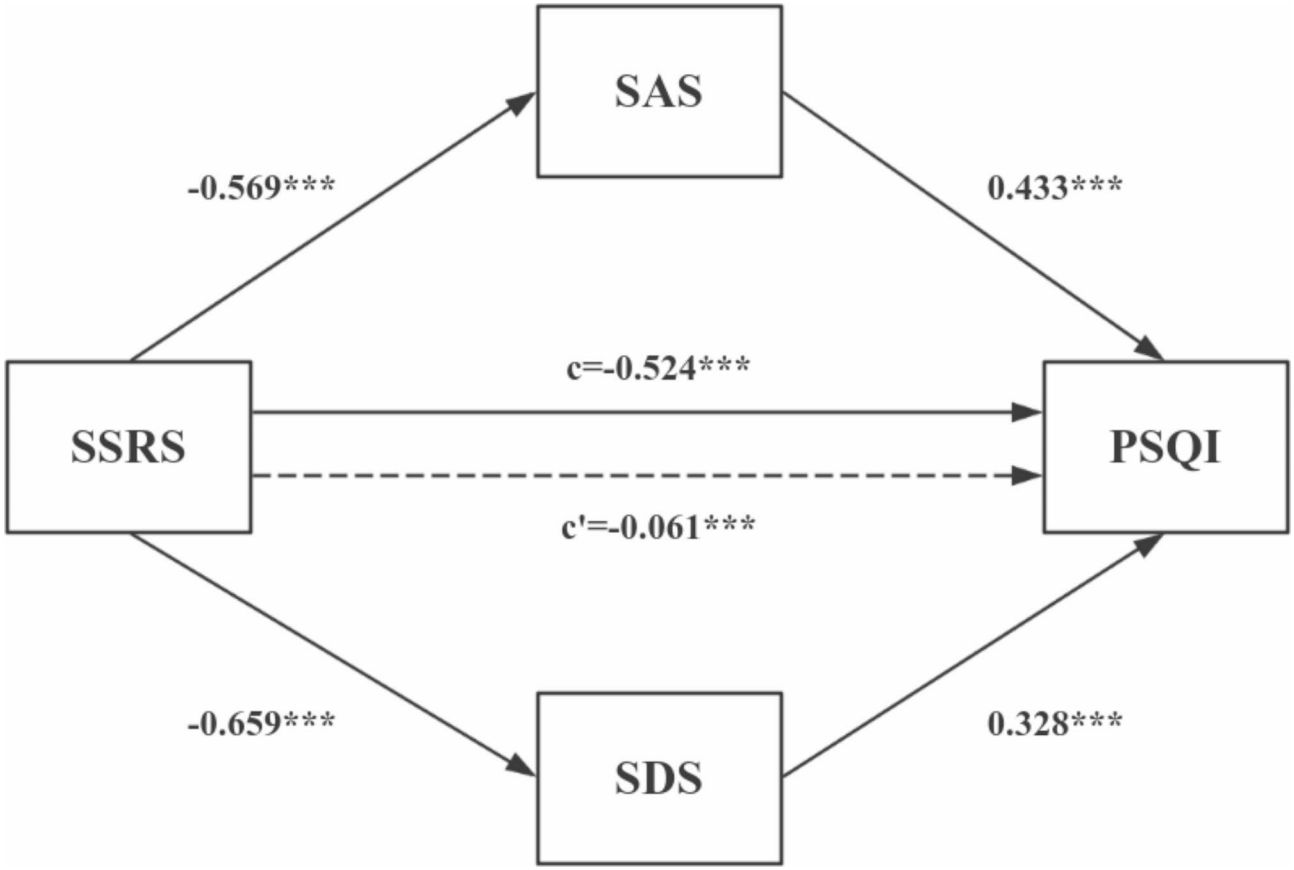

Fig. 1. Mediation model of anxiety and depression symptoms between social support and sleep quality without control variables. The coefficient c is the total effect between X and Y, and c' is the direct effect of X on Y whilst controlling for M_1 and M_2. All path coefficients are standardized. ***$P < 0.001$.

the significance of the mediation model and supports the notion that interventions aimed at enhancing social support and addressing anxiety and depression could lead to improvements in sleep quality.

Discussion

The present study employed canonical correlation analysis to examine the associations between social support and sleep quality, while also investigating the potential mediating roles of anxiety and depressive symptoms. Notably, a significant positive correlation was observed between social support and sleep quality, as evidenced by the standardized canonical correlation coefficients. The first pair of canonical variables accounted for an impressive 97% of the cumulative contribution, explaining 68.9% of the variance in social support and 49.0% in sleep quality. Furthermore, it was confirmed that anxiety and depression partially mediated the relationship between social support and sleep quality.

The substantial loading of subjective support (-0.886) in our analysis underscores the critical role of perceived emotional support in sleep quality. This finding aligns with Cohen and Wills'[41] stress-buffering hypothesis, suggesting that the perception of available support may be more crucial than actual received support in mitigating stress and promoting better sleep. This interpretation is further corroborated by Troxel[42], who posited that perceived social support might be broadly beneficial for sleep by promoting positive health behaviors and fostering a sense of belonging.

Interestingly, our findings diverge from those of Proulx et al. (2020)[43], who reported no significant association between social support and overall self-reported sleep quality among older benzodiazepine users. However, they did observe a significant association between satisfaction with social support and daytime dysfunction related to poor sleep quality. This discrepancy may be attributed to differences in study populations and specific measures employed, highlighting the complex and context-dependent nature of the relationship between social support and sleep quality.

Our analysis revealed that daytime dysfunction, subjective sleep quality, and sleep disruptions were the most significant aspects of sleep quality associated with social support. This finding provides a more comprehensive picture compared to previous studies that often focused on limited aspects of sleep quality[42,43]. The high loading of daytime dysfunction (0.848) in our study underscores the far-reaching impact of poor sleep quality on daily functioning, an aspect that has been underexplored in previous research linking social support and sleep.

Another interesting finding of this study is that the indirect effect exerted a dominant influence on the total effect, highlighting the pivotal role of psychological factors in determining sleep quality. Specifically, it was observed that social support indirectly enhanced individuals' sleep quality by mitigating symptoms of anxiety and depression. These findings align with the results reported by Zhang et al. (2021)[44], indicating a positive association between low levels of social support and elevated anxiety and depressive symptoms among individuals in standardized residency training programs. Similarly, Zamanian et al. (2021)[45] observed negative correlations between all subscales of social support and symptoms of depression and anxiety among women diagnosed with breast cancer. Furthermore, our study extends the existing research conducted by Xiao et al. (2020)[4] and Grey et al.(2020)[19], who separately investigated the roles of anxiety, depression, social support, and sleep quality. By simultaneously considering both mediators, our study offers a more comprehensive model that elucidates the intricate interplay among these factors.

Taken collectively, these findings have several important implications for clinical practice and public health initiatives. Our findings suggest that interventions aimed at improving sleep quality should adopt a comprehensive approach that encompasses strategies to enhance social support and address mental health concerns. This multifaceted approach may yield greater efficacy than interventions focusing solely on sleep hygiene or pharmacological treatments. Given the significant impact of subjective support and support utilization, interventions should prioritize enhancing individuals' perception of available support and their ability to effectively utilize support resources. Based on the findings of Zamanian et al. (2021)[45], interventions should also emphasize teaching functional coping strategies, particularly positive reframing and acceptance, which can potentially augment the beneficial effects of social support on sleep quality by reducing anxiety and depressive symptoms.

In general, the significance of this study lies in its emphasis on the role of social support in enhancing an individual's sleep quality, as well as highlighting the importance of psychological factors in the relationship between social support and sleep quality. This finding holds important implications for public health practice, particularly emphasizing the crucial role of social support and psychological well-being when designing and implementing interventions aimed at improving sleep quality. By strengthening social support networks and providing mental health services, it may be possible to contribute to enhancing sleep health in the general population, thereby improving overall quality of life.

There are certain limitations inherent in this study. Firstly, the utilization of a cross-sectional study design precludes us from establishing a causal relationship between social support and sleep quality, and it is crucial to acknowledge the potential existence of a bidirectional association between anxiety/depression and social support. Future investigations may benefit from employing a longitudinal study design to track temporal changes in variables, thereby enhancing our understanding of how social support influences sleep quality. Secondly, it is important to acknowledge that the sample utilized in this study was derived from a specific region and population, thus limiting generalizability to other cultural and contextual settings. To comprehensively comprehend this relationship, it is imperative to expand sample coverage by including populations from diverse regions, cultures, and socio-economic backgrounds. Furthermore, the data was collected during the COVID-19 pandemic, as noted by Akbari et al. (2023)[46], self-reported measures collected during periods of significant psychological distress, such as the COVID-19 pandemic, may be subject to recall bias and potentially overestimate the strength of reported associations. Also, it is crucial to consider the small effect size observed for the investigated relationships when interpreting the findings.

In addition, future investigations could explore other potential mediating variables, such as stress coping strategies and lifestyle habits, that may play a role in mediating the relationship between social support and sleep quality. Finally, to enhance the objective understanding of the association between social support and sleep quality, it is recommended that future studies incorporate objective assessment tools like clinical observations or physiological indicators instead of relying solely on self-reporting scales which might be influenced by subjective bias.

Conclusions

This study employs CCA to elucidate the intricate, multidimensional relationship between social support and sleep quality, while examining the mediating roles of anxiety and depressive symptoms. Through CCA, we were able to analyze social support and sleep quality as multifaceted constructs. The analysis revealed that subjective support and support utilization are the most influential components of social support, while daytime dysfunction, subjective sleep quality, and sleep disruptions are the aspects of sleep quality most closely associated with social support. This multidimensional analytical approach uncovered complex interactions that might be overlooked by traditional univariate analyses. Furthermore, the results of mediation analysis indicated that anxiety and depression partially mediated the relationship between social support and sleep quality. These findings underscore the intricate interplay among social support, mental well-being, and sleep quality, highlighting the imperative for multifaceted interventions aimed at enhancing sleep quality that encompass bolstering social support and managing mental health. Future research should strive to further elucidate the causal mechanisms underpinning these relationships and develop targeted interventions tailored to diverse population subgroups. By persistently exploring these interconnections, we can endeavor towards more comprehensive and efficacious approaches to ameliorating sleep quality and consequently overall health and quality of life.

Data availability

The datasets generated for this study are available on request to the corresponding author.

Received: 18 May 2024; Accepted: 4 November 2024

Published online: 07 November 2024

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Acknowledgements
We thank all the participants in the study, and we are also grateful to research assistants who participated in the study for their assistance in research coordination and data collection.

Author contributions
J.X. designed the study. Q.X. and J.Y. is responsible for the data collection and cleaning. Y.C. conducted the data analysis. Y.C. and Q.X. wrote the manuscript. J.X. and J. T reviewed and revised the manuscript.

Funding
This work was supported by the Guangdong Basic and Applied Basic Research Foundation (2023A1515110169), the Humanities and Social Sciences Youth Foundation, Ministry of Education of the People's Republic of China (Grant Number: 22YJCZH209) and the Research Start-Up Funds of Guangdong Medical University (Grant Number: 4SG24300G).

Declarations

Competing interests
The authors declare no competing interests.

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