The Relationship between Quality of Life, Bone Pain, Skin Pruritus and Depression among Patients with Secondary Hyperparathyroidism: A Cross-Sectional Study

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Abstract

Background Secondary hyperparathyroidism (SHPT), a manifestation of chronic kidney disease-mineral bone disorder (CKD-MBD), is common in CKD patients and has significant morbidity and mortality. Quality of life (QOL) in SHPT patients is seriously affected by symptoms such as bone pain and skin pruritus. However, studies have focused on operative effects and hypocalcemia rather than the relationships between QOL, bone pain, skin pruritus and depression symptoms.

Methods A cross-sectional survey was conducted from January 2017 to December 2019 in a third-class hospital in China. The brief table of the QOL measurement scale (QOL-BREF), a self-designed bone pain and skin pruritus scale and the Self-rating Depression Scale (SDS) were used to estimate QOL, bone pain and skin pruritus, and depression, respectively. Pearson's correlation, multiple linear regression analysis and structural equation modeling (SEM) were used for analysis.

Results Overall, 320 questionnaires were considered valid (98.46% effective response rate). The prevalence of bone pain, skin pruritus and depression was 94.06%, 69.06%, and 77.81%, respectively. Bone pain, skin pruritus and depression were significantly associated with QOL. In SEM, QOL negatively correlated with bone pain (r=-0.509), skin pruritus (r=-0.517) and SDS (r=-0.465). Bone pain significantly ($P < 0.01$) and positively correlated with skin pruritus ($r = 0.568$) and SDS ($r = 0.450$). Skin pruritus significantly ($P < 0.01$) and positively correlated with SDS ($r = 0.426$). In addition, QOL partially mediated the association between bone pain or skin pruritus and depression (mediation proportion of 48.62% or 45.08%).

Conclusions SHPT patients have high depression levels and poor QOL due to bone pain and skin pruritus. The effects on depression may be fully mediated by the impact of bone pain or skin pruritus on QOL. Thus, bone pain or skin pruritus could increase depression via the intermediary role of QOL.For clinical front-line medical staff,it can relieve bone pain and skin pruritus through timely operation and psychological intervention, so as to improve patients' quality of life and reduce anxiety.At the same time, we should also pay attention to the high-risk groups.

Background

SHPT is a common complication of CKD that is characterized by derangements in the homeostasis of calcium, phosphorus and vitamin D[1]. SHPT causes high-turnover bone disease, leading to a decrease in bone mass[2]. Loss of bone mass is mainly manifested by increased cortical bone, with a reduction of bone resorption and mineralized bone on the surface of the cortex due to mineralization defects, with severe bone pain and fracture in severe cases[3]. Pruritus is an unpleasant feeling associated with the urge to scratch; it is a subjective symptom that is caused by many factors and has multiple dimensions[4]. The causes of skin pruritus in patients with SHPT may be related to the increase in parathyroid hormone (PTH), hyperphosphatemia and the accumulation of some medium and large molecular toxins, such as β2-mg, in vivo[5]. Parathyroidectomy (PTX) is the main treatment at present

and might also reduce calcium-phosphorus product concentrations, PTH and inflammatory factors, thus controlling vascular calcification and relieving bone pain and skin pruritus[6].

Studies have shown that low QOL and severe physical discomfort can affect patients' mental health, especially depressive symptoms[7]. In this study, we hypothesize that there is a mediating effect between bone pain, skin pruritus and depression.

QOL is a concept used to evaluate the quality of life in a comprehensive way, which should be based on living standards, but its meaning is more complex and extensive[8]. Kim et al.'s research[9] showed that QOL had a strong correlation with pain and depression or anxiety. McIntyre et al.'s research[10] showed that QOL had a mediating effect between symptoms and depression, which indicated that QOL can indirectly affect depression as a mediating variable. JungHye et al.'s research[11] proposed a QOL protection model, and the model considered QOL as a protective factor that can regulate the negative impact of risk factors on development outcomes.

In this study, it is assumed that QOL plays a regulatory role in the mediation model of bone pain, skin pruritus and depression.

In summary, this study hypothesizes that there is a relationship between QOL, bone pain, skin pruritus and depression and that QOL has a mediating effect between bone pain, skin pruritus and depression.

Methods

Participants and data collection

A cross-sectional study was conducted in a third-class hospital in Liaoning Province, China, from January 2017 to December 2019. The patients with SHPT were aware of the content of the survey before their participation, and on the day before the questionnaires were distributed, with the agreement of the Northern Theater General Hospital ethics committee, we issued informed consent forms to each patient. A total of 325 questionnaires were distributed, and those that were missing more than 20% of values or had low writing quality were excluded from this survey. In total, 320 questionnaires were considered valid (98.46% effective response rate).

Measures

Measurement of QOL

We measured QOL by using the brief table of the quality of life measurement scale (QOL-BREF). The QOL-BREF, a self-reported scale, has 24 items, and each item has a 5-point Likert-type scale ranging from 1 to 5. The total score of the scale ranges from 16 to 80, and higher scores indicate better QOL. There are four dimensions in this instrument: the physiological dimension, the psychological dimension, the social relation dimension and the environmental dimension[12]. In this study, the Cronbach's α coefficient of internal consistency for the overall scale was 0.857.

Measurement of bone pain and skin pruritus

We used the Visual Analog Scale (VAS) to measure bone pain. This scale draws a long horizontal line on the paper; one end of the horizontal line is 0, indicating no pain, the other end is 10, indicating severe pain, and the middle region indicates different degrees of bone pain[13]. This method was also used to measure the degree of skin pruritus.

Measurement of depression

The Self-rating Depression Scale (SDS) was completed by Dr W.K. Zung. This scale is composed of 20 items and 4 dimensions: psychoemotional symptoms, somatic disorders, neuromotor disorders and psychological disorders. The SDS asks about the degree of depression in patients using a 4-point Likert Scale that ranges from never (1 point) to always (4 points), and the total score ranges from 20 to 80[14]. In this study, the Cronbach's α coefficient of internal consistency for the overall scale was 0.842.

Statistical analysis

SPSS 21.0 and AMOS 23.0 were used for the statistical analyses. We conducted descriptive analyses of the sociodemographic variables and Pearson correlation analysis of the other variables. Multiple linear regression analysis was used to test the mediating effect, and the bootstrap method in the AMOS structural equation model was used to further verify the mediating effect. The process of parameter estimations could exclude measurement error[15]. According to related research and theories, a hypothetical relationship model was created and is shown in Figs. 1 and 2. Two SEM models were presented, as follows: QOL is an intermediary variable between bone pain, skin pruritus and depression. The structural path hypothesis is that bone pain and skin pruritus have direct and indirect effects through depression. Furthermore, it shows the results for goodness-of-fit indexes obtained with SEM for the total sample and individual samples.

Results

Demographic characteristics of the participants

There were 320 patients with SHPT in this study: 172 (53.8%) were males, and 148 (46.2%) were females. The age of the patients ranged from 20 to 70 years. The years of renal failure ranged from 2 to 30, and the average was 10.71 ± 4.64 years. The years of SHPT ranged from 1 to 9, and the average was 3.07 ± 2.13 years.

Descriptive statistics

The QOL score ranged from 25 to 68, with an average of 41.76 ± 8.15. The scores for bone pain and skin pruritus ranged from 1 to 10, with averages of 5.08 ± 2.65 and 3.58 ± 3.19, respectively. The years of bone pain ranged from 0 to 10, and the average was 2.30 ± 1.95. The years of skin pruritus ranged from 0 to 8, and the average was 2.13 ± 2.05. The SDS score ranged from 20 to 65, and the average was 46.04 ± 8.98. The preoperative PTH ranged from 588 to 2934 pg/ml, and the average was 1729.15 ± 376.20 pg/ml. The

serum calcium ranged from 1.95 to 2.93 mmol/L, and the average was 2.43 ± 0.19 mmol/L. The serum phosphorus ranged from 1.30 to 3.59 mmol/L, and the average was 2.38 ± 0.52 mmol/L. The comparative results of each scale for SHPT patients with different demographic characteristics are shown in Table 1.

Table 1
Descriptive statistics (N = 320)

Variable	QOL		Bone Pain		Skin Pruritus		SDS	
	t/F	P	t/F	P	t/F	P	t/F	P
Gender	2.066	0.040	-3.313	0.001	-3.300	0.001	-3.156	0.002
Age	1.635	0.181	2.325	0.075	0.428	0.733	2.524	0.058
Marital status	5.783	0.001	5.407	0.001	5.786	0.001	0.309	0.819
Occupation	2.339	0.042	4.708	0.000	4.974	0.000	10.076	0.000
Education	0.688	0.601	2.589	0.037	2.807	0.026	2.949	0.020
Income	2.185	0.090	1.453	0.228	2.153	0.093	5.659	0.001
Residential area	0.207	0.892	0.337	0.798	0.463	0.708	0.955	0.414
Insurance	1.866	0.116	0.617	0.651	1.428	0.225	2.884	0.023

Preliminary correlation analyses

The Pearson correlation analysis of QOL, bone pain, skin pruritus and SDS is presented in Table 2. The results showed that QOL was significantly (P < 0.01) and negatively correlated with bone pain (r=-0.509), skin pruritus (r=-0.517) and SDS (r=-0.465). Bone pain was significantly (P < 0.01) and positively correlated with skin pruritus (r = 0.568) and SDS (r = 0.450). Skin pruritus was significantly (P < 0.01) and positively correlated with SDS (r = 0.426).

Table 2
Correlations between the main variables (N = 320)

Variable	QOL	Bone pain	Skin pruritus	SDS
QOL	1			
Bone pain	-0.509**	1		
Skin pruritus	-0.517**	0.568**	1	
SDS	-0.465**	0.450**	0.426**	1
Note:**P < 0.01				

Testing for the mediation effect

The variable was normalized first, and three regression equations were established according to the purpose of this study. Eq. 1: depression as the dependent variable and bone pain or skin pruritus as the independent variable; Eq. 2: QOL as the dependent variable, with SDS and bone pain or skin pruritus as the independent variable; and Eq. 3: SDS as the dependent variable, with QOL and bone pain or skin pruritus as the independent variable. The results showed that bone pain and skin pruritus could significantly predict depression (β = 0.485/0.375, P = 0.000) and that bone pain and skin pruritus could significantly predict QOL (β=-0.407/-0.337, P = 0.000). When bone pain or skin pruritus and QOL predicted SDS at the same time, the predictions were significant (β = 0.310/0.223, P = 0.000; β=-0.429/-0.450, P = 0.000). This indicated that the direct or indirect effects of bone pain or skin pruritus on SDS were significant; that is, QOL plays an intermediary role between bone pain or skin pruritus and SDS. The results are shown in Tables 3 and 4.

Table 3
The moderating effects of QOL (Part 1)

Equation	Dependent variable	Independent variable	β	SE	t	P
Equation 1	SDS	Bone pain	0.485	0.054	8.984	0.000
Equation 2	QOL	Bone pain	-0.407	0.039	-10.548	0.000
Equation 3	SDS	Bone pain	0.310	0.060	5.190	0.000
		QOL	-0.429	0.075	-5.740	0.000

Table 4
The moderating effects of QOL (Part 2)

Equation	Dependent variable	Independent variable	β	SE	t	P
Equation 1	SDS	Skin pruritus	0.375	0.045	8.404	0.000
Equation 2	QOL	Skin pruritus	-0.337	0.031	-10.757	0.000
Equation 3	SDS	Skin pruritus	0.223	0.050	4.510	0.000
		QOL	-0.450	0.076	-5.929	0.000

Verification of the mediating effect

On the basis of multivariate regression analysis, the bootstrap method was used to further test the intermediary effect of QOL. To test the intermediary effect, we needed to establish a structural equation model, and we used AMOS 23.0 to test it. The specific path analysis diagram is shown in Figs. 1 and 2.

The structural equation model fit results showed that CMIN/DF = 2.437/1.202 (< 3); AGFI = 0.928/0.965, GFI = 0.960/0.980, TLI = 0.961/0.994, IFI = 0.973/0.996, and CFI = 0.973/0.996 (> 0.9); and SRMR = 0.042/0.026 and RMSEA = 0.067/0.025 (< 0.08), indicating that the model fit well. The results showed that the confidence intervals for both the direct and indirect effects of bone pain and skin pruritus on SDS did not reach 0. The mediating effect model of QOL was established, and the mediating effect was 0.212/0.275, accounting for 48.62%/45.08% of the total effect. See Tables 5 and 6 for details.

Table 5
Results for total, indirect and direct effects of bone pain on SDS with QOL as a mediator

	SE	Bias-Corrected		Percentile	
		95%CI		95%CI	
		Lower	Upper	Lower	Upper
total effect					
Bone pain—SDS	0.436	0.279	0.585	0.276	0.581
indirect effect					
Bone pain—QOL—SDS	0.212	0.101	0.371	0.069	0.336
direct effect					
Bone pain—SDS	0.224	0.053	0.43	0.061	0.438

Table 6
Results for total, indirect and direct effects of skin pruritus on SDS with QOL as a mediator

	SE	Bias-Corrected		Percentile	
		95%CI		95%CI	
		Lower	Upper	Lower	Upper
total effect					
Skin pruritus—SDS	0.61	0.435	0.795	0.433	0.792
indirect effect					
Skin pruritus—QOL—SDS	0.275	0.188	0.378	0.183	0.374
direct effect					
Skin pruritus—SDS	0.335	0.179	0.493	0.179	0.492

Discussion

The depression status of SHPT patients

With the transformation of medical models into biological/psychological/social models[16], the phenomenon of bodily disease accompanied by anxiety and depression has attracted wide attention in the field of medical psychology. The main symptoms of patients with SHPT are depression, memory loss, insomnia, nightmares, etc[17]. However, there are few investigations on QOL and depression psychology at home and abroad. In this study, patients had a high level of depression, with an incidence of 77.81%. The average SDS score was 46.04 ± 8.98, which was higher than the norm[18]. This result indicated that the mental health level of patients with SHPT was low, which suggested that more attention should be paid to patients with SHPT in China. The generation of depressive symptoms includes many factors, such as pain, pruritus, occupation, education, income, and insurance[19], but in the early stage of depression, relieving discomfort over time and giving timely social or emotional support can largely avoid the occurrence of depression[20]. The SDS score of male patients in this study was higher than that of female patients; however, this is different from Chun's findings[21], which may be related to the fact that men are under more economic pressure and most patients are unable to work due to hemodialysis. There were significant differences in SDS scores among patients with different occupations, education, incomes, and insurance, which may be because the patients with high education and a good job generally enjoy higher medical insurance reimbursement and take Cinacalet, lanthanum carbonate and other drugs to alleviate SHPT[22].

The status of SHPT patients' QOL, bone pain, and skin pruritus

No related surveys on QOL, bone pain, or skin pruritus in patients with SHPT have been reviewed at home or abroad. In this study, the average QOL score was 41.76 ± 8.15, which was lower than the norm[23], and the average score for bone pain was 5.08 ± 2.65, which was higher than the norm[24]. This was consistent with Galvez's[25] and Rehman's[26] findings. In this study, skin pruritus had a greater impact on the patient's body than bone pain. PTX can improve the symptoms of bone pain caused by bone deficiency and hypocalcemia.

The mediating effect of QOL

The results of Pearson correlation analysis showed that QOL, bone pain, skin pruritus and depression were significantly correlated with each other and that bone pain and skin pruritus positively predicted the level of depression. This was consistent with the results obtained by Brophy et al[27]. and laid the foundation for the subsequent analysis of mediating effects. Notably, regression analysis revealed that there was a partial mediating effect between bone pain, skin pruritus and depression, which provided a basis for the verification of mediating effects. At the same time, some studies also showed that patients with low QOL have a significantly higher risk of depression, and QOL is an important predictor of depression in SHPT patients, which is basically consistent with the results of this study.

The bootstrap method was used to further verify the mediation effect. The results showed that a mediating effect of QOL between bone pain, skin pruritus and depression was established, and the mediating effect was 48.62%/45.08%. BI also confirmed that QOL played a role in mediating depression[28]. In clinical work, we should encourage SHPT patients to improve symptoms causing discomfort through PTX in a timely manner, which can greatly reduce depression and improve QOL.

Conclusions

In summary, QOL, bone pain,skin pruritus and depression are closely related in patients with SHPT and there may be a full mediating effect of QOL between bone pain or skin pruritus and depression. It is suggested that alleviating bone pain and skin pruritus in SHPT patients can alleviate the state of depression through the mediating effect of QOL.

List Of Abbreviations

QOL-BREF	QOL measurement scale
SDS	Self-rating Depression Scale
SEM	structural equation modeling
PTH	parathyroid hormone
PTX	Parathyroidectomy
QOL-BREF	the quality of life measurement scale
VAS	the Visual Analog Scale

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Authors' Contributions

Ting Bi carried out the studies, participated in collecting data, and drafted the manuscript. Xiaodong Feng, Wei Zhang, Guangming Cheng, and Chunhui Wang performed the statistical analysis and participated in its design. Yufu Tang, Sijia Bai, and Shuai Guo participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

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Figures

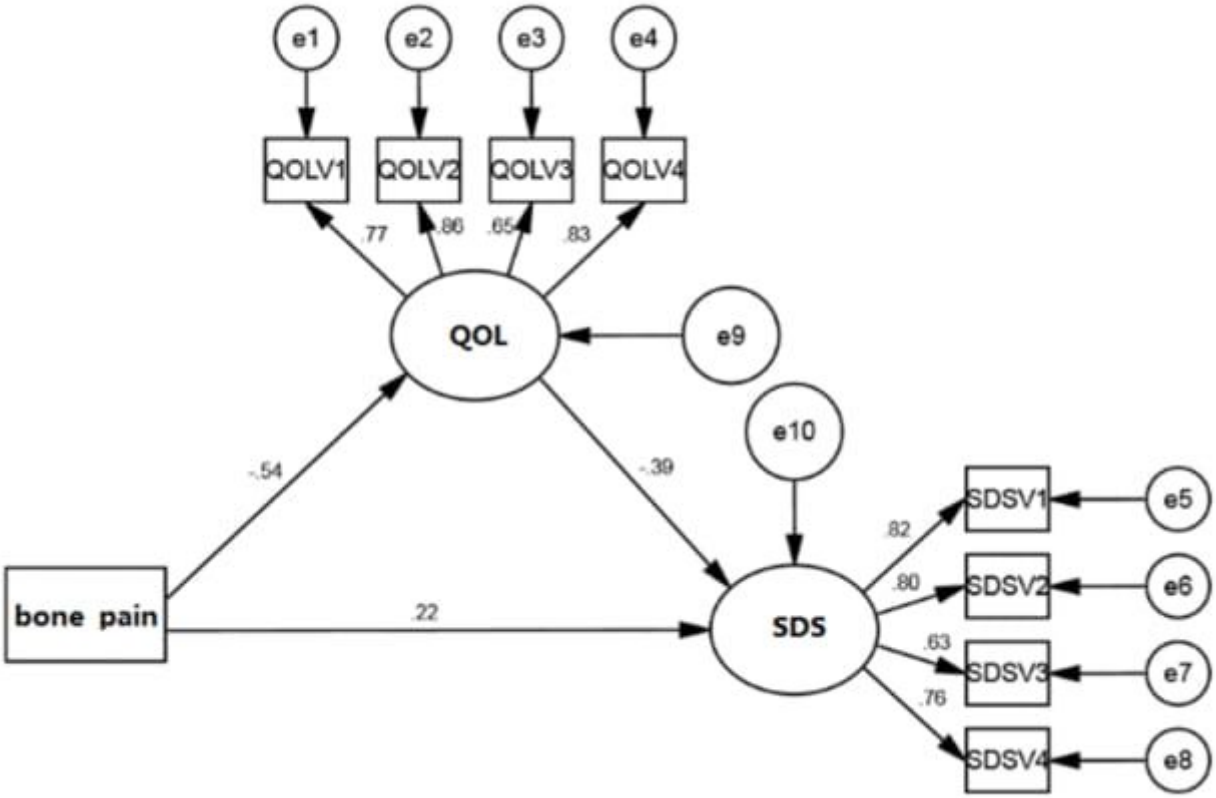

Figure 1

Mediating effect of QOL on bone pain and SDS.

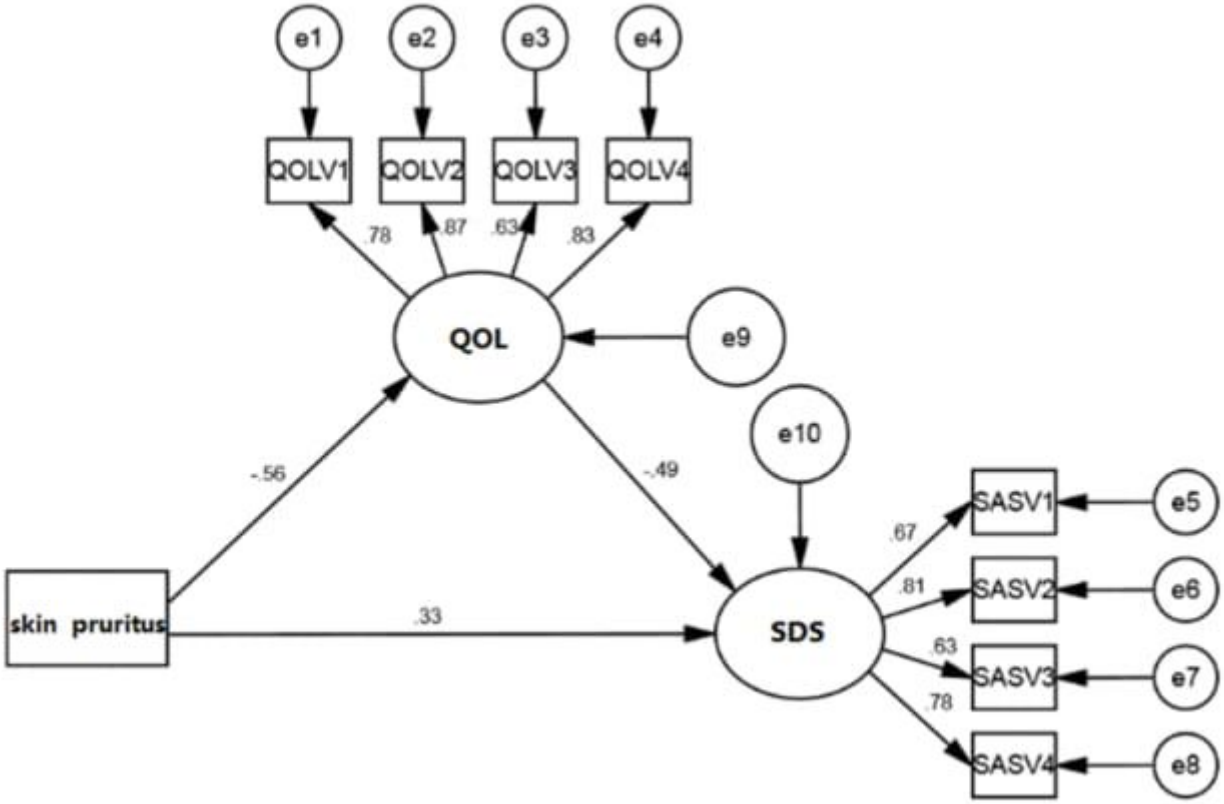

Figure 2

Mediating effect of QOL on skin pruritus and SDS.