Prevalence and Associated Factors of Uraemic Pruritus in Continuous Ambulatory Peritoneal Dialysis Patients

Jianying Li, Qunying Guo, Jianxiong Lin, Chunyan Yi, Xiao Yang and Xueqing Yu

Abstract

Objective  Uraemic pruritus is a distressing symptom that has a negative impact on the quality of life for dialysis patients. The pathophysiology of pruritus in peritoneal dialysis (PD) patients is still poorly understood. The present study aims to investigate the prevalence and related risk factors of pruritus in continuous ambulatory peritoneal dialysis (CAPD) patients.

Methods  In total, 362 CAPD cases were investigated from January 2012 to April 2013. Pruritus was assessed by visual analogue scale.

Results  The prevalence of severe pruritus and mild to moderate pruritus was 12.7% and 52.5%, respectively. The patients with severe pruritus had the longest duration of PD (p<0.001), Pittsburgh Sleep Quality Index (PSQI) score (p<0.001), Beck Depression Inventory (BDI) score (p=0.003), intact parathyroid hormone (iPTH) level (p=0.009), and the lowest Medical Outcomes Short Form 36 Health Survey, Physical Component Score (SF-36 PCS) (p<0.001) among the three groups. The patients with mild to moderate pruritus had a significantly higher iPTH level (p=0.004) compared with the patients without pruritus. A multivariate logistic regression for pruritus showed that higher PSQI score [odds ratio (OR)=1.305, p=0.001], higher BDI score (OR=1.429, p=0.002), longer vintage (OR=1.039, p=0.004), and higher iPTH level (OR=1.317, p=0.014) were independently associated with pruritus.

Conclusion  The prevalence of uraemic pruritus was 65.2% in CAPD patients. Sleep disorder, depression, longer vintage, and a higher iPTH level were independent associated factors for pruritus in CAPD patients.

Key words: peritoneal dialysis, pruritus, depression, sleep disorder, quality of life

Materials and Methods

Objectives

This was a single-center, cross-sectional, and observational study. The present study aimed to investigate the prevalence and related risk factors of pruritus in CAPD patients.

Participants

The inclusion criteria were as follows, patients who: 1) had received CAPD for more than 3 months; 2) are older than 18 years of age; 3) can provide a signed informed consent form. The exclusion criteria were as follows, patients who: 1) have a presence of malignancy and active infection; 2) have required an operation within the prior month; 3) have had a recent hospitalization within 1 month; 4) have a psychotic disorder or dementia; 5) have acute hepatitis or have had a recent hospitalization before PD. The data for demographic information, clinical data, and record of skin problems were collected.

Ethics

The study protocol was approved by the Ethics Committee of The First Affiliated Hospital at Sun Yat-sen University. The PD patients were investigated from January 2012 to April 2013 at our PD patients’ clinic. Only the patients who agreed to participate in this study and signed the informed consent form were enrolled. The printed questionnaire in Chinese, which includes the visual analogue scale, sleep quality survey, Medical Outcomes Short Form 36 Health Survey, and Beck Depression Inventory-II, was completed by the patients during the visit.

Pruritus treatment and assessment

The severity of pruritus was assessed by the visual analogue scale (VAS), which ranged from 0 to 10 (0 = no pruritus to 10 = intolerable pruritus) as described in a previous study (6). Each patient completed the VAS with the help of study nurses. According to their VAS scores, the patients were divided into three groups: no pruritus was defined as VAS scores = 0 (group 1); mild to moderate pruritus was defined as VAS scores = 1-5 (group 2); and severe pruritus was defined as VAS scores ≥5 (group 3). Of the patients, 16.4 percent of them received oral antihistamine for pruritus, as needed.

Assessment of sleep quality

The Chinese version of the Pittsburgh Sleep Quality Index (PSQI) had been validated for sleep quality for Chinese dialysis patients (11). It contains 19 questions and yields a global PSQI score ranging from 0 to 21. Patients with PSQI scores ≥5 were considered to be “poor sleepers” and those with a score of <5 were considered to be “good sleepers”.

Assessment of quality of life

The QoL was measured by the Medical Outcomes Short Form 36 Health Survey (SF-36), which has been validated for the Chinese population and for patients receiving dialysis treatment (12). This was a short-form measure of a patient’s general health status, which included a physical component score (PCS) and a mental component score (MCS). A higher score indicates a better QoL.

Assessment of depression

The Beck Depression Inventory-II (BDI-II) was used for an assessment of depression in CAPD patients. Depression was defined as a BDI-II score ≥14, which was based on a diagnosis standard that is used for dialysis patients (13).

Assessment of malnutrition-inflammation status

The malnutrition-inflammation score (MIS) included the 7-component conventional subjective global assessment (SGA) of nutrition and 3 other elements [body mass index (BMI), serum albumin, and serum transferrin]. There are 4 levels of severity, ranging from 0 (normal) to 3 (very severe) for each MIS component (11).

Assessment of comorbidity

Each patient’s comorbidity score was calculated according to the Charlson Comorbidity Index (CCI), by assigning a weight of 2 to diabetes, stroke, renal insufficiency, and malignancy and a weight of 1 to the other comorbidities (14).

Statistical analyses

The patients’ characteristics were presented as mean ± SD for continuous variables, and showed as the median (1st and 3rd quartile) for abnormally distributed continuous variables. Categorical variables were shown as percentages. A one-way analysis of variance (ANOVA) test was used for normally distributed variables among the three groups. A comparison of abnormally distributed continuous variables was performed using a non-parametric Kruskal-Wallis test. For categorical variables, a Chi-square test was used. A post hoc Dunnett’s test was used to compare groups 1 and 2, group 1 and 3, and group 2 and 3.

Sex, age, time of dialysis, diabetes, CCI, and factors that reached statistical significance were selected for further multivariable analyses. Logistic regressions and multivariate linear regressions were performed for a multivariable-adjusted analysis to explore the predictors of pruritus, depression, sleep disorder and QoL. All calculations were performed with SPSS 13.0 (Statistical Product and Service Solutions,
A total of 516 patients were followed regularly at the clinic from January 2012 to April 2013. Due to the exclusion criteria, 62 patients were excluded. Ninety-two patients declined to participate in this study. In the end, 362 PD patients were recruited.

**Patient demographics**

A total of 362 CAPD patients (53.6% men, mean age 49.9±16.7 years) were observed, with a median PD duration of 16 months. The etiology of End-Stage Renal Disease (ESRD) was chronic glomerulonephritis in 193 cases (53.4%), hypertensive nephrosclerosis in 37 cases (10.2%), diabetic nephropathy in 100 cases (27.7%), polycystic kidney disease in 8 cases (2.2%), and unknown causes in 24 cases (6.5%).

**Prevalence of pruritus**

The prevalence of severe, mild to moderate pruritus, and no pruritus was 12.7%, 52.5%, and 34.8%, respectively.

**Characteristics of CAPD patients with pruritus**

Among the three groups, the patients with severe pruritus had the longest duration of PD (p<0.001), the highest diabetes mellitus proportion (p=0.013), PSQI score (p<0.001), BDI score (p=0.003), MIS score (p=0.013), and intact parathyroid hormone (iPTH) level (p=0.009) and the lowest SF-36 PCS (p<0.001). Furthermore, the patients with mild to moderate pruritus had a significantly higher iPTH level (p=0.004) compared with the patients without pruritus (as shown in Table 1, Fig. 1, 2).

**Multivariate logistic regression analysis for pruritus, sleep disorder, and depression in CAPD patients**

The multivariable-adjusted logistic regression model showed that the PSQI (OR=1.305, p=0.001), BDI (OR=1.429, p=0.002), time of PD (OR=1.039, p=0.004), and iPTH level (OR=1.317, p=0.014) were independent predictors for pruritus after adjusting for age, sex, diabetes, PD duration and season. Pruritus (OR=1.653, p=0.01), BDI (OR=1.065, p=0.024), and MIS score (OR=1.186, p=0.014) were independent predictors for sleep disorder after adjusting for age, sex, PD duration, diabetes and CCI. The variables female (OR=6.458, p=0.013), diabetes (OR=1.83, p=0.004), and PSQI (OR=1.171, p=0.018) were independent predictors for depression after adjusting for age, sex, PD duration, diabetes and CCI (as shown in Table 2).

**Multivariate linear regression analysis for QOL in CAPD patients**

In a multiple linear regression analysis, the BDI (β=−0.31, p=0.001), MIS score (β=−0.26, p=0.001), age (β=−0.25, p=0.001), and higher calcium × phosphate product (β=−0.15, p=0.019) were independent predictors for PCS. In addition, sleep disorder (β=−0.27, p=0.001), depression (β=−0.40, p=0.001), and age (β=0.18, p=0.024) were independent predictors for MCS (as shown in Table 3).

**Discussion**

In this present study, the prevalence of severe pruritus and mild to moderate pruritus was 12.7, and 52.5%, respectively. Sleep disorder, depression, longer PD duration, and higher iPTH level were independent predictors for pruritus in CAPD patients. After controlling for potential confounding factors, significant associations among uremic pruritus, sleep quality, and depression were demonstrated in CAPD patients.

We demonstrated bidirectional associations existing between pruritus and sleep quality in CAPD patients. Pruritus was shown to be an independent risk factor for sleep disorder, while sleep quality was also shown to be an independent predictor for pruritus in this study. Indeed, severe uremic pruritus have been reported to occur more often at night (15). Patients with extreme pruritus had a 2.3 to 4.1 times greater adjusted odds ratio of not having enough sleep, either being sleepy during the day or being awake at night (16). Thus, DOPPS suggested that pruritus was associated with a higher mortality risk due to pruritus-induced sleep disturbance in HD patients (8). Moreover, the presence of sleep disorder at night may affect pruritus perception. Previous studies suggested that a dysfunction of the circadian rhythm, involving the release of itch mediators, was associated with the aggravation of pruritus (17), which indicated sleep disturbances were associated to the development of severe pruritus. Therefore, in addition to the previous unidirectional speculation that pruritus causes sleep disturbances in HD patients, results from the present study revealed a bidirectional association between pruritus and sleep disturbances in CAPD patients.

Another interesting finding of this study was that depression was also an independent risk factor for pruritus. Previous studies reported an increased sensitivity to aversive stimuli due to depressive symptom-inducing chemical changes in serotonergic or noradrenergic function (18), which suggested that depressive symptoms might worsen pruritus. Another longitudinal analytic study suggested that patients with depressive symptoms were likely to show a future risk of severe pruritus, furthermore, depressive symptom-induced sleep disturbances were also possibly associated to the development of severe pruritus (19). These reports were in agreement with our results suggesting an association between pruritus and depressive symptoms. Moreover, both pruritus and depression were the bidirectional factors of sleep quality in this study. Several studies have reported the relationship between depressive symptoms and subsequent development of sleep disturbances (20, 21). These findings supported the presumption that sleep distur-
biance was an intermediate variable in the relationship between depressive symptoms and pruritus.

Our finding showed the severity of patient-reported pruritus and its relationship with PCS QoL scores. This finding was similar to what was reported by Curtin et al. (16), who described a significant inverse relationship between pruritus and PCS QoL scores. This finding was consistent with some studies that showed higher serum C-reactive protein and lower serum albumin levels were observed in patients with severe pruritus compared to those without it (6). Inflammation may play a role in the development of pruritus among HD patients. Some studies have reported HD patients with severe pruritus tended to have increased inflammatory parameters (6, 23). However, no inflammatory marker was independently associated with pruritus after correcting for potential confounders in the present study. Since our previous study demonstrated a strong association between MIS and poor sleep quality (11), sleep disorder may be the confounder for the relationship between malnutrition-inflammation status and pruritus.

An interrelationship between pruritus, malnutrition, and inflammation had been demonstrated in the present study. MIS was used as a tool to assess the malnutrition-inflammation status and a significant positive correlation between pruritus and MIS among the PD patients has been found. Moreover, the higher high-sensitivity C-reactive protein (hsCRP) level and MIS score that was observed in patients with severe pruritus in the present study was consistent with some studies that showed higher serum C-reactive protein and lower serum albumin levels were observed in patients with severe pruritus compared to those without it (6). Inflammation may play a role in the development of pruritus among HD patients. Some studies have reported HD patients with severe pruritus tended to have increased inflammatory parameters (6, 23). However, no inflammatory marker was independently associated with pruritus after correcting for potential confounders in the present study. Since our previous study demonstrated a strong association between MIS and poor sleep quality (11), sleep disorder may be the confounder for the relationship between malnutrition-inflammation status and pruritus.

In this study, the Kt/V values and residue renal failure (RRF) were not different between the patients with pruritus and the patients without pruritus. This result was consistent with the other previous studies which reported that the Kt/V level and RRF were not associated with the prevalence and degree of pruritus in dialysis patients (2, 6). Kt/V is a repre-

Table 1. Clinical, Demographic and Biochemical Characteristics in 362 CAPD Patients with and without Pruritus.

<table>
<thead>
<tr>
<th></th>
<th>All patients (n = 362)</th>
<th>No pruritus (n = 126)</th>
<th>Mild to moderate pruritus (n = 190)</th>
<th>Severe pruritus (n = 46)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>53.6</td>
<td>51.5</td>
<td>56.6</td>
<td>51.2</td>
<td>0.773</td>
</tr>
<tr>
<td>Age (year)</td>
<td>49.9 ±16.7</td>
<td>47.6 ±15.1</td>
<td>48.8 ±15.9</td>
<td>58.5 ±14.3</td>
<td>0.007*</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>27.7</td>
<td>15.7</td>
<td>34.1</td>
<td>34.8*</td>
<td>0.013*</td>
</tr>
<tr>
<td>Vintage (months)</td>
<td>16 (10, 29.7)</td>
<td>13.5 (8, 22.5)</td>
<td>18 (11, 31)</td>
<td>23 (12.5, 48)*</td>
<td>0.001*</td>
</tr>
<tr>
<td>Occupational status 1/2</td>
<td>208/154</td>
<td>35/91</td>
<td>58/132</td>
<td>8/38</td>
<td>0.115</td>
</tr>
<tr>
<td>PSQI</td>
<td>9.4 ± 4.1</td>
<td>7.7 ± 5.3</td>
<td>9.3 ± 4.2</td>
<td>12.3 ± 5.6</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>BDI score</td>
<td>10 (5, 18.8)</td>
<td>10.4 (4, 19.3)</td>
<td>8 (4, 13)</td>
<td>17(6, 22)</td>
<td>0.033*</td>
</tr>
<tr>
<td>MIS score</td>
<td>4.5 ± 2.7</td>
<td>4.1 ± 2.4</td>
<td>4.4 ± 2.4</td>
<td>5.9 ± 3.7</td>
<td>0.013*</td>
</tr>
<tr>
<td>CCI</td>
<td>4.6 ± 1.9</td>
<td>4.4 ± 1.9</td>
<td>4.2 ± 1.6</td>
<td>5.8 ± 2.3</td>
<td>0.102</td>
</tr>
<tr>
<td>PCS</td>
<td>40.7 ± 7.8</td>
<td>41.2 ± 7.5</td>
<td>42.5 ± 6.4</td>
<td>36.0 ± 9.5</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>MCS</td>
<td>44.9 ± 9.8</td>
<td>45.2 ± 9.7</td>
<td>43.7 ± 10.2</td>
<td>42.9 ± 9.7</td>
<td>0.454</td>
</tr>
<tr>
<td>BMI</td>
<td>23.3 ± 3.1</td>
<td>22.7 ± 2.8</td>
<td>21.9 ± 3.3</td>
<td>22.5 ± 2.9</td>
<td>0.399</td>
</tr>
<tr>
<td>Dialysis dose (L/Day)</td>
<td>8.4 ± 0.5</td>
<td>8.2 ± 0.4</td>
<td>8.6 ± 0.4</td>
<td>8.6 ± 0.3</td>
<td>0.519</td>
</tr>
<tr>
<td>Season(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.248</td>
</tr>
<tr>
<td>Spring</td>
<td>25.5</td>
<td>30.9/39 (126)</td>
<td>21(40/190)</td>
<td>29.2(13/46)</td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>32.8</td>
<td>33.8/42 (126)</td>
<td>20(38/190)</td>
<td>12.5(6/46)</td>
<td></td>
</tr>
<tr>
<td>Autumn</td>
<td>18.2</td>
<td>14.7/19 (126)</td>
<td>28(33/190)</td>
<td>20.8(10/46)</td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>23.4</td>
<td>20.6/26 (126)</td>
<td>31(39/190)</td>
<td>37(17/46)</td>
<td></td>
</tr>
<tr>
<td>Prealbumin (g/L)</td>
<td>1.8 (0.8, 6.6)</td>
<td>1.4 (0.5, 6.6)</td>
<td>1.9 (0.9, 4.8)</td>
<td>2.6 (1.3, 10.9)</td>
<td>0.084</td>
</tr>
<tr>
<td>Albmin (g/L)</td>
<td>106.8 ± 18.6</td>
<td>105.9 ± 21.5</td>
<td>107.8 ± 16.5</td>
<td>105.2 ± 18.1</td>
<td>0.68</td>
</tr>
<tr>
<td>Creatinine (umol/L)</td>
<td>936.2 ± 330.2</td>
<td>904.6 ± 294.1</td>
<td>947.6 ± 323.3</td>
<td>962.1 ± 396.7</td>
<td>0.822</td>
</tr>
<tr>
<td>Albumin (g/L)</td>
<td>38.1 ± 4.2</td>
<td>38.6 ± 4.0</td>
<td>38.4 ± 4.2</td>
<td>36.5 ± 4.2</td>
<td>0.087</td>
</tr>
<tr>
<td>Prealbumin (g/L)</td>
<td>337.9 ± 82.9</td>
<td>348.8 ± 79.7</td>
<td>337.1 ± 88.9</td>
<td>312.1 ± 61.8</td>
<td>0.179</td>
</tr>
<tr>
<td>Transferrin (g/L)</td>
<td>2.3 ± 0.5</td>
<td>2.4 ± 0.5</td>
<td>2.3 ± 0.5</td>
<td>2.2 ± 0.4</td>
<td>0.152</td>
</tr>
<tr>
<td>Calcium (mmol/L)</td>
<td>2.4 ± 0.2</td>
<td>2.5 ± 0.2</td>
<td>2.4 ± 0.2</td>
<td>2.4 ± 0.3</td>
<td>0.14</td>
</tr>
<tr>
<td>Phosphate (mmol/L)</td>
<td>1.7 ± 0.5</td>
<td>1.6 ± 0.5</td>
<td>1.7 ± 0.5</td>
<td>1.8 ± 0.6</td>
<td>0.284</td>
</tr>
<tr>
<td>Ca×P product (mg2/dL2)</td>
<td>50.4 ± 16.5</td>
<td>47.2 ± 13.8</td>
<td>53.2 ± 16.6</td>
<td>56.8 ± 19.5</td>
<td>0.103</td>
</tr>
<tr>
<td>iPTH (pg/L)</td>
<td>265.0 (128.4, 412.5)</td>
<td>215.8 (113.2, 353.4)</td>
<td>255.1 (130.6, 535.3)</td>
<td>327.7 (126.4, 610)</td>
<td>0.009*</td>
</tr>
<tr>
<td>RRF (mL/min 1.73m²)</td>
<td>1.5 (0.5, 3.1)</td>
<td>1.7 (0.3, 3.9)</td>
<td>1.5 (0.4, 2.8)</td>
<td>1.5 (0.6, 2.7)</td>
<td>0.394</td>
</tr>
<tr>
<td>Kt/V</td>
<td>2.2 ± 0.5</td>
<td>2.1 ± 0.4</td>
<td>2.2 ± 0.6</td>
<td>2.1 ± 0.4</td>
<td>0.403</td>
</tr>
</tbody>
</table>

*a: compared with no pruritus group, p <0.05
b: compared with mild to moderate pruritus group, p <0.05

PSQI: Pittsburgh Sleep Quality Index, BDI: Beck Depression Inventory, MIS: malnutrition inflammation score, CCI: Charlson Comorbidity Index, PCS: physical component score, MCS: mental component score, hsCRP: high-sensitivity C-reactive protein, Hb: hemoglobin, Ca×P product: calcium × phosphate product, iPTH: intact parathyroid hormone, BMI: body mass index, RRF: residue renal failure, BP: blood pressure
#1: Employed 2 Retired, unemployed, housewife

sentative of clearance of small molecular solute. Similar to previous studies, the present study has shown that the accumu-
lation of middle molecular uremic toxins, such as iPTH, was significantly correlated to uraemic pruritus in CAPD pa-
tients. Regrettably, the data of another representative of mid-
dle molecular toxin of Beta-2 microglobulin was not collected in the present study. Therefore, further study is needed to 
testify the relation between pruritus and the removal of mid-
dle molecule uremic toxin. Theoretically, RRF loss should 
contribute to the uremic pruritus, since the clearance of the 
uremic toxins decreases along with the loss of RRF. How-
ever, the RRF did not show any relationship with pruritus in 
a cross-sectional and single-center study. The prevalence of 
pruritus was multifactorial and was influenced by center 
bias. Although confounders have been adjusted by statistical 
efforts, the effect of treatment for pruritus was not included 
in the model because we did not have enough data for 
analysis, which may cause bias in analyzing for the risk fac-
tors for pruritus. Moreover, it cannot be completely pre-
cluded whether the associations are causal or if any residual 
confounder remains. In addition, it was not possible to de-
termine whether pruritus anteceded the appearance of de-
pression symptoms and sleep problems among PD patients. 
Further study is necessary to explore the complex relations-
ships involving pruritus, sleep problems, and depression, in 
order to develop a better understanding of their conse-
quences and pathogenesis in CAPD patients.

**Limitation**

Some limitations of this study should be noted. This was a cross-sectional and single-center study. The prevalence of 
pruritus was multifactorial and was influenced by center bias. Although confounders have been adjusted by statistical 
efforts, the effect of treatment for pruritus was not included in the model because we did not have enough data for analysis, which may cause bias in analyzing for the risk factors for pruritus. Moreover, it cannot be completely precluded whether the associations are causal or if any residual confounder remains. In addition, it was not possible to determine whether pruritus anteceded the appearance of depression symptoms and sleep problems among PD patients. Further study is necessary to explore the complex relationships involving pruritus, sleep problems, and depression, in order to develop a better understanding of their consequences and pathogenesis in CAPD patients.

**Conclusion**

Our study clearly demonstrated strong correlations existing between pruritus, sleep quality, and depressive symp-
toms in CAPD patients. After learning about the high preva-
lence of pruritus and related factors in the PD patients, we suggested effective interventions to alleviate depression and sleep disturbance symptoms, which may be beneficial for uraemic pruritus in CAPD patients.
Table 3. Multivariate Linear Regression Models for Predictors of Quality of Life.

<table>
<thead>
<tr>
<th>Variable</th>
<th>PCS *</th>
<th>p value</th>
<th>95% CI for B</th>
<th>MCS *</th>
<th>p value</th>
<th>95% CI for B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.25</td>
<td>0.001**</td>
<td>-0.28 - 0.10</td>
<td>0.18</td>
<td>0.024*</td>
<td>0.12 - 1.05</td>
</tr>
<tr>
<td>Vintage</td>
<td>-0.16</td>
<td>0.122</td>
<td>---</td>
<td>-0.02</td>
<td>0.698</td>
<td>---</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.09</td>
<td>0.182</td>
<td>---</td>
<td>0.02</td>
<td>0.793</td>
<td>---</td>
</tr>
<tr>
<td>PSQI</td>
<td>0.173</td>
<td>---</td>
<td>---</td>
<td>0.07</td>
<td>0.001**</td>
<td>-1.24 - 0.15</td>
</tr>
<tr>
<td>BDI</td>
<td>-0.31</td>
<td>0.001**</td>
<td>-1.02 - 0.15</td>
<td>0.00</td>
<td>0.001**</td>
<td>-0.59 - 0.14</td>
</tr>
<tr>
<td>VAS</td>
<td>0.378</td>
<td>---</td>
<td>---</td>
<td>0.01</td>
<td>0.924</td>
<td>---</td>
</tr>
<tr>
<td>MIS</td>
<td>0.001**</td>
<td>-0.082 - 0.14</td>
<td>0.698</td>
<td>---</td>
<td>0.529</td>
<td>---</td>
</tr>
<tr>
<td>CCI</td>
<td>0.073</td>
<td>---</td>
<td>---</td>
<td>0.03</td>
<td>0.351</td>
<td>---</td>
</tr>
<tr>
<td>Ca×P</td>
<td>-0.15</td>
<td>0.019*</td>
<td>-0.13 - 0.01</td>
<td>0.981</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Notes: * p < 0.05; ** p < 0.01
d. dependent variable: PCS, e. dependent variable: MCS, PCS : physical component score, MCS: mental component score, PSQI: Pittsburgh Sleep Quality, BDI: Beck Depression Inventory, VAS: visual analogue scale, MIS: malnutrition inflammation score, CCI: Charlson Comorbidity Index, Ca × P product: calcium × phosphate product

The authors state that they have no Conflict of Interest (COI).

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