Original Article

Association of pruritus with sleep in patients with psoriasis and chronic spontaneous urticaria: A cross-sectional study

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Abstract

Background: Pruritus is a frequent complaint associated with various inflammatory dermatoses. Sleep is often disturbed because of pruritus but the impact of severity and diurnal pattern of pruritus has not been studied so far. **Objectives:** To estimate the prevalence of nocturnal itch (NI) and its association with itch severity, sleep disturbance and quality of life (QoL) compared with non-NI in chronic plaque psoriasis (CPP) and chronic spontaneous urticaria (CSU). **Methods:** We performed a cross-sectional study in patients aged ≥18 years with CPP or CSU for at least 6 weeks. A comprehensive in-house questionnaire designed for study formed the basis for categorizing patients into NI and non-NI. Validated instruments like visual analog scale, pruritus grading system, General Sleep Disturbance Scale, and Dermatology life quality index were used to assess itch severity, sleep, and QoL. **Results:** A total of 255 patients (CPP: 131; CSU: 124) were included in this study. Prevalence of NI was 43.5% (95% confidence interval: 34.9%-52.4%) in CPP and 29% (95% confidence interval: 21.2%-37.9%) in CSU. NI was strongly associated with higher pruritus grading system scores in CSU and CPP (regression coefficient = 1.5, P =0.004 and regression coefficient = 1.3, P =0.004, respectively), with impaired sleep (OR = 2.97, P = 0.025) in CPP and with itch-affected sleep in CSU. Itch severity was associated with impaired sleep; however, the association was modified by the presence of NI in CSU patients. **Conclusion:** Nocturnal itch is prevalent in chronic dermatoses and significant for sleep deficit and impaired QoL. Early screening and management of sleep disturbance among patients presenting with nocturnal itch should be routinely undertaken.

Keywords: Nocturnal pruritus, psoriasis, quality of life, sleep, urticaria

Introduction

Pruritus is the primary symptom in a number of inflammatory dermatoses that dermatologists encounter in their daily practice. Chronic plaque psoriasis (CPP) and chronic spontaneous urticaria (CSU) are some prevalent chronic skin diseases, and pruritus is the most common as well as worrisome symptom

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affecting the majority of these adults.[1-3] CPP has long been associated with stress attributed to itch, pain, and sleep disturbance leading to poorer quality of life (QoL). Despite our growing understanding of the genetic and molecular basis of the disease, its cure remains elusive. As for CSU, a large number of patients have trouble finding the optimal therapeutic regime. Understanding the role of nocturnal pruritus can potentially help in risk stratification and therapeutic advancement in these patients.

Sleep is a complex state that is extremely vulnerable to disruption caused by various conditions, including dermatological illnesses.[4-8] Accumulating evidence suggests that pruritus occurring during night is more critical for sleep deficits and poor QoL than pruritus occurring during day time.[9,10] However, the exact impact of itch pattern and severity, especially of nocturnal itch, on chronic dermatologic conditions such as CSU and CPP is not clearly defined. Furthermore, sleep evaluation is generally overlooked and undertreated in chronic dermatologic diseases. Therefore, understanding pruritus-related sleep disruptions in these diseases is critical for optimal patient management. The present study was conducted to fill the above lacunae, with the purpose of estimating the prevalence of nocturnal itch and its association with itch severity, sleep disturbances, and QoL in CSU and CPP patients.

Materials and Methods

Study population - Patients were recruited consecutively from dermatology out-patient department of a tertiary care referral center over a span of two years. Approval from the institutional ethical committee was obtained prior to the commencement of the study. A total of 124 patients of CSU and 131 patients of CPP were enrolled after obtaining a written informed consent. Inclusion criteria for participating in this study were patients with age ≥18 years who were able to read and write and suffering with itch due to either CPP or CSU for a period longer than 6 weeks. Patients with mixed dermatoses, underlying known chronic medical conditions, psychiatric issue, malignant or central nervous system disease, sleep disorders, pregnancy/lactation, pustular/erythrodermic psoriasis, psoriatic arthritis, angioedema, and shift workers were excluded. Patients who had taken any oral medications for their dermatological conditions for the past two weeks were also excluded from the study, with the exception of some over-the-counter sleep medications other than oral antihistamines and pain medications. Psoriasis diagnosis was made based on clinical manifestations, and histopathological examination was used in 38 doubtful cases. Diagnosis of CSU was confirmed clinically in all patients, where recurrent episodes of urticaria persisting beyond 6 weeks without any external stimulus was diagnosed as CSU.[11]

Research tools - A semi-structured questionnaire was used for the study. This questionnaire was divided into the following subsections.

1. Demographic characteristics included age, gender, education level, and employment status.
2. Disease severity was evaluated by Psoriasis Area and Severity Index and the Urticaria Activity Score 7 in CPP and CSU, respectively.
3. Assessment of diurnal itch pattern - We developed a comprehensive questionnaire on the basis of a critical review of literature, discussions with patients, expert opinions, and using our prior experience. Appendix S1 contains the final version of the questionnaire that was used for the study and the steps toward its formulation. Accordingly, patients were categorized into two groups – (A) Nocturnal itch (NI), including the patients with the subjective experience of the peak intensity of itch at night (22:00 to 06:00 hours) as reported by patients themselves and (B) Non-nocturnal itch (NNI) with rest of the patients.
4. Other validated scales - The itch severity, sleep, and QoL were assessed using the Visual Analog Scale (VAS) and pruritus grading system (PGS), General Sleep Disturbance Scale (GSDS), and Dermatology Life Quality Index (DLQI), respectively. Permission from respective copyright owners of DLQI and GSDS were obtained.

Outcomes: The primary outcomes were itch severity, sleep disturbance, and QoL.

Itch severity: VAS for itch intensity is a 10 cm long line that was positioned horizontally in our study, and patients were asked to record the maximum severity of their itch in the previous three days (VAS_{max}), with 0 indicating no itch and 10 indicating the worst imaginable itch. In addition to VAS, PGS scale was used to objectively characterize pruritus based on the distribution of itch (single site/multiple site/generalized), frequency of itch (episodic/frequent/continuous), the severity of itch (rubbing/scratching/localized excoriations/generalized excoriations), and sleep disturbance (rare/occasional/frequent/totally restless), with a score of 0-5 indicating mild, 6-11 as a moderate grade, and 12-19 as a severe grade. The quantitative VAS and PGS scores were used in the analyses while itch-affected sleep measured through the subscale of PGS was included as a categorized variable in the analyses.

Sleep disturbance: Patients were given the GSDS questionnaires. GSDS has 21 items organized into six domains: difficulty in falling asleep, waking up during sleep, quality of sleep, quantity of sleep, daytime sleepiness, and usage of sleep-inducing substances. A mean score of 3 on the GSDS or any of the subscales indicates clinically significant sleep disturbance, and higher values indicate more seriously disturbed sleep. We primarily used impaired sleep as the outcome of interest and secondarily validated by using quantitative sleep scores.

QoL: Patients were also given the DLQI questionnaires. The DLQI is a set of 10 questions (with a total score ranging from 0 to 30 points) that are used to assess the impact of a dermatological disorder on the impairment of a patient's QoL, such as

symptoms, feelings, daily activities, leisure activities, work/school, personal relationships, and therapy. It can be classified as having no effect (0-1), a small effect (1-5), a moderate effect (5-10), a large effect (10-20), or an extremely large effect (≥20). Impaired QoL was used in the primary analyses and associations were confirmed with the analyses of quantitative QoL scores.

Statistical analysis and sample size

Data were analyzed using STATA 17 (Chicago, USA). The prevalence of NI was estimated with a 95% confidence interval (CI) using a binomial distribution for each disease separately. All baseline characteristics were initially compared according to the disease (CSU vs. CPP) groups. The quantitative data were represented as mean and standard deviation (SD) and the qualitative data as frequency and percentage. In the unadjusted analysis of comparing all data between groups, unpaired *t*-test or Chi-square test was used depending on the type of variables. The associations of NI and itch severity with disease condition were determined using multivariable logistic regression analyses after adjusting for all baseline covariates in the model. Similarly, multivariable logistic regression analyses were performed to determine adjusted association of NI with impaired sleep and QoL. The association of itch severity with impaired sleep and QoL was evaluated separately for NI and NNI group. These analyses were further validated by using quantitative sleep and QoL scores multivariable linear regression analyses and itch-affected sleep as measured by PGS. All these analyses were performed separately for CSU and CPP.

The results of logistic regression analyses were summarized with odds ratio (OR) with 95% CI and *P* value. The results of linear regression analyses were summarized with regression coefficient (RC) with 95%CI and *P* value while results of multinomial logistic regression analysis were summarized with relative risk ratio (RRR) with 95%CI and *P* value. *P* value <.05 was considered as a statistically significant result. Because distinct scales for assessing disease severity like Psoriasis Area and Severity Index and Urticaria Activity Score 7 were employed for the two disease groups (CPP and CSU, respectively), a z-standardized score was used in the analyses so as to make the severity between groups comparable. The sample size of 245 was calculated to produce a 95% CI for NI, assuming the prevalence of nocturnal pruritus of 18% with a confidence width of 10%.[10]

Results

Patient characteristics and outcomes

A total of 255 patients including 131 CPP and 124 CSU were recruited in this study. The average age of patients was 32.6 (SD: 11.6) years with 32.5% females. Approximately half of the patients had a working occupation status and more than half had received education till secondary school or below (56.9%) [Table 1]. Of total, 36.5% of the patients had reported NI with a mean itch severity score of 6.4 (SD: 2.2) and mean PGS score of 8.1 (SD: 2.7). Majority of the patients (84.6%) had a moderate or severe itch grade with 24% affecting sleep and 34% affecting itch severity. Also, 18.8% had impaired sleep, whereas 70.6% had poor QoL [Table S1].

NI, itch severity, and dermatologic conditions

Table 1 shows the distribution of patient characteristics by their dermatologic condition. CSU patients had more females and unemployed occupational status than CPP patients. The prevalence of NI (43.5%; 95% CI: 34.9%-52.4%) was significantly higher in CPP compared to CSU. The sleep disturbance and QoL scores were not significantly different between the two groups. However, itch severity score measured by VAS was found to be significantly higher in CSU patients, while itch grade score measured by PGS was higher in CPP patients without any differences in itch-affected sleep disturbances.

Association of NI with itch severity

NI patients had higher itch grade score (9.0 ± 2.8) compared to NNI patients (7.6 ± 2.5, *P* <.006) without any differences in itch severity measured on VAS (6.9 vs. 6.2, *P* = 0.14) or PGS (40.9% vs. 29.8%, *P* = 0.18). In the multivariable analyses, NI was associated with increased itch severity particularly in CPP patients (RC = 0.86, *P* = .041) and itch grade in CSU (RC = 1.54, *P* = .004) and CPP (RC = 1.34, *P* = .004) patients after adjusting for age, gender, occupation status, and disease severity [Table 2].

Association of NI with sleep and QoL

NI patients were significantly associated with higher sleep (36.6 ± 12.9 vs. 30.9 ± 11.7, *P* <.001) and QoL (10.4 ± 5.3 vs. 8.4 ± 5.2, *P* =0.003) scores than NNI patients. The presence of NI was also significantly associated with impaired sleep (26.9% vs. 14.2%, *P* =0.013), QoL (81.7% vs. 64.2%, *P* = .003), higher itch grade (89.3 vs. 82%, *P* = .006), and itch-affected sleep disturbances (36.6% vs. 16.3%, *P* <.001). In the adjusted analysis [Table 3], NI was associated with impaired sleep (OR = 2.62, *P* = .005), itch-specific sleep quality (OR = 5.14, *P* <.001), and poor QoL (OR = 3.10, *P* =.004). NI was consistently associated with impaired sleep and QoL in CPP patients. However, NI was only associated with itch-affected sleep in CSU patients (OR = 9.43, *P* <.001). These results were unchanged in the analyses of quantitative sleep and QoL scores [Table S2].

Association of itch severity with sleep and QoL between NI and NNI

In the stratified analyses, itch severity was associated with impaired sleep in CSU with NI patients (OR = 2.57, *P* = 0.017) but not in CSU without NI patients (OR = 1.17, *P* = 0.373). The itch severity was associated with impaired sleep regardless of NI (OR = 1.57, *P* =.013) or NNI (OR = 1.88, *P* = .009) status in CPP. The itch severity was associated with poor QoL to a similar extent in both NI and NNI group and in each dermatologic condition. These results were unchanged with quantitative scores analyses [Table S3].

Table 1: Characteristics of patients by dermatologic conditions

Factor	Total (*n*=255)	CSU (*n*=124)	CPP (*n*=131)	*P*
Age, mean (SD)	32.6 (11.6)	31.8 (11.9)	33.3 (11.3)	0.33
Gender-female	83 (32.5%)	59 (47.6%)	24 (18.3%)	<0.001
Education				0.17
Graduate and above	76 (29.8%)	32 (25.8%)	44 (33.6%)	
High school and Inter	34 (13.3%)	14 (11.3%)	20 (15.3%)	
Secondary and below	145 (56.9%)	78 (62.9%)	67 (51.1%)	
Occupation				<0.001
Unemployed	84 (32.9%)	51 (41.1%)	33 (25.2%)	
Working	123 (48.2%)	39 (31.5%)	84 (64.1%)	
Housewife	48 (18.8%)	34 (27.4%)	14 (10.7%)	
Standardized PASI/UAS, mean (SD)	0.0 (1.0)	0.0 (1.0); 10.9 (8.5)	-0.0 (1.0); 19.7 (14.7)	1.00
Nocturnal itch	93 (36.5%)	36 (29.0%)	57 (43.5%)	0.016

SD, standard deviation

Table 2: Association of nocturnal itch with the severity of itch measured by VAS and PGS grade

	RC	95% CI		*P*
Itch severity (VAS)				
Overall#	0.67	0.13	1.22	0.016
CSU*	0.29	-0.47	1.05	0.456
CPP*	0.86	0.04	1.68	0.041
PGS grade				
Overall#	1.49	0.83	2.15	<0.001
CSU*	1.54	0.51	2.56	0.004
CPP*	1.34	0.43	2.25	0.004

RC, regression coefficient; CI, confidence interval; #Adjusted diagnostic group, disease severity, age, gender, and occupation status;*Adjusted disease severity, age, gender, and occupation status

Table 3: Association of nocturnal itch with impaired sleep, itch-affected sleep, and poor quality of life

	OR	95% CI		*P*
Impaired sleep				
Overall#	2.62	1.33	5.16	0.005
CSU*	1.69	0.59	4.85	0.325
CPP*	2.97	1.15	7.69	0.025
Itch-affected sleep				
Moderate vs. low				
Overall#	2.28	1.18	4.39	0.014
CSU*	5.02	1.69	14.90	0.004
CPP*	1.58	0.65	3.79	0.31
Severe vs. low				
Overall#	5.14	2.52	10.49	<0.001
CSU*	9.43	2.81	31.59	<0.001
CPP*	3.64	1.42	9.37	0.007
Poor QoL				
Overall#	3.10	1.60	5.98	0.001
CSU*	2.05	0.70	5.95	0.189
CPP*	3.71	1.54	8.96	0.004

OR, odds ratio; CI, confidence interval; #Adjusted diagnostic group, disease severity, age, gender, and occupation status;*Adjusted disease severity, age, gender, and occupation status

Discussion

Sleep disturbances are closely associated with chronic dermatologic conditions and have a detrimental effect on health.[12] There is plenty of literature searching for the link between pruritus and sleep disturbance in patients of psoriasis and urticaria.[7,13-15] In addition to the above, a cohort study has also found evidence of sleep disturbance as an instigating factor for the development of CSU.[8] As for pruritus, its perception can fluctuate through the course of the day and has been demonstrated in CPP and CSU in previous studies.[16,17] The primary goal of this study was to estimate the prevalence of nocturnal pruritus and the association thereof with sleep disturbance in CSU and CPP. We found a slightly higher prevalence of NI than the previously reported 39% patients of CPP and 21% patients of CSU who had aggravation of itch in the night.[16,17]

A bidirectional relationship between sleep and the immune system has been researched upon and is suggestive of the influence exerted by sleep disturbance on increasing the disease activity.[18] Assessment of sleep disorders thus plays a pivotal role in the management of the dermatological conditions and can be undertaken subjectively using various scales and tools like Pittsburg sleep quality index, Athens insomnia scale, Insomnia severity index, and GSDS.[19] All these scales are self-rated questionnaires differing from each other in the various components of sleep study, with some overlapping elements. For instance, Insomnia severity index and Athens insomnia scale are seven-item and eight-item questionnaires, respectively, that give a quantitative index of severity of insomnia in the past one month.[19] Pittsburg sleep quality index, on the other hand, is a 19-item questionnaire that does not analyze the presence or absence of insomnia but rather the sleep quality in the past four weeks.[19] GSDS is a reliable tool to measure sleep disturbance and is consistent with DSM-V insomnia criteria.[20,21] It is easier to use and assesses different variables that could lead to sleep disturbance.

The mean GSDS scores were similar across both our disease groups, and impaired sleep was experienced by an almost equal proportion of patients of CSU and CPP. A high incidence of clinically significant sleep disturbance has been reported in psoriasis and urticaria, attributed mainly to pruritus.[22] Recently, a case-control study demonstrated a significantly high proportion of psoriasis patients (53.9%) that suffered from poor sleep owing

to itching.[23] These authors found itch and depressive symptoms to be the most consistent statistical predictors of insomnia and poor sleep. Another study reported 76.3% patients with poor sleep quality and 83.3% with short sleep duration in patients affected with psoriasis.[24] Similarly, for the patients suffering with CSU, researchers have found association with impaired sleep in as high as 60% of their patients.[12] Furthermore, it has also been demonstrated that majority of CSU patients had interference in daily functioning and problems maintaining sleep.[25] The absolute percentages of patients with poor sleep in our study were not as high as those reported above. But expectedly, the NI group had significantly more sleep disturbance that was evident on GSDS as well as PGS scales.

The severity of itch is commonly assessed using VAS, which is a mono-dimensional pruritus severity scale. Although it is regarded as a convenient and reliable scale, use of a single measure does not ensure a comprehensive assessment of chronic pruritus and needs to be supplemented with other scales for evaluation of the same.[26,27] We used PGS to serve this purpose, that is a multidimensional scale and was first introduced by Szepietowski for objective assessment of itch in patients with uremic pruritus.[28] Previous studies have recorded a mean VAS score of 5.2-6.4 in psoriasis, which was similar to ours.[29] *Al-Qarqaz et al.*[30] have found similar results for PGS in most of their psoriasis patients, except for only episodic itch. Also, similar findings have been reported for CSU in another study.[31] Majority of our patients had a moderate grade of PGS scores. There was the involvement of multiple sites or generalized distribution along with frequent itch in both CSU and CPP. The VAS_{max} (0-10) itch severity scores in our study were significantly more for CSU than CPP. Paradoxically, the itch grade according to PGS did not differ significantly between the two, and itch severity was significantly more for CPP. Again, between the NI and NNI groups despite showing no significant difference in VAS, PGS scores were significantly higher for NI. The above contradictory results justify the need to use additional scales for VAS.

DLQI is a reliable tool to measure QoL in skin diseases and has found use in a number of these conditions.[32] Literature review suggests that DLQI scores reach as high as 9.1 in urticaria and 10.9 in psoriasis, where a score more than 10 indicates a large impact on life quality.[33,34] These were similar to those found in our study and significantly higher in those with NI. Also, the maximum number of patients suffering from CPP and CSU had a poor QoL, with a significantly higher proportion under the NI group. The QoL, as expected and corroborated with previous studies, was worse with increasing itch severity, but surprisingly not for those with NNI in CSU.[31]

The strength of the present study belies the demonstration of the independent role played by nocturnal pruritus in causing sleep disturbances and worsening the QoL significantly more than its non-nocturnal counterpart. A few limitations such as validation of the itch questionnaire used in the study, lack of usage of psychometric tools to assess patients' psychological status such that any recent-onset psychological or sleep disorders at the time of recruitment might have been missed, presence of caffeine intake, and continued usage of topical corticosteroids/antiitch (calamine) lotions as required can be recognised. Also, a specific QoL scale related to itch could not be used in the study. Future multicentric studies with larger sample size and objective assessment of sleep could help to understand the complex relationship between pruritus, sleep, and QoL. Overall, the present study takes our existing knowledge further about the association between pruritus and sleep disturbances in two of the common chronic dermatologic ailments. With the advent of multiple therapeutic modalities and a customized approach to individual patients' pruritus patterns, one can hope to alleviate more symptoms and improve the life quality of these patients.

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Conflicts of interest

There are no conflicts of interest.

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Appendix S1

Development of questionnaire

To carefully assess for the itch characteristics with a special attention toward its timing, a pretest questionnaire was developed. A critical review of literature on pruritus and discussion with patients was undertaken along with physical or telephonic discussion with clinicians who are experts in the field of pruritus. Initial items of the questionnaire were adapted from 5D itch scale, 12-item pruritus severity scale, and articles on pain variation, focusing on pruritus timing according to pain, as there was lack of scale related to pruritus timing on literature review. We added time slots in the questionnaire like Early morning - 06:00-09:00 am, Daytime - 09:00-17:00 pm, Evening - 17:00-22:00 pm, Nocturnal - 22:00-06:00 am, Uniform itch intensity throughout the day, that was partially adapted from PQRST assessment of pain and the study on diurnal rhythmicity of pain in fibromyalgia patients by Bellamy *et al.** The remaining items of questionnaire were divided into different domains, where four pertained to itch timing (Q1,4,9,10), and the rest to other features associated with itch like extent, intensity, aggravating, and relieving factors (Q2,3,6,7,8). Initial version of the questionnaire was administered to 20 patients of CSU who were not being treated for their chronic pruritus and included both open-ended questions and specific responses.

The questionnaire was filled in by these patients with the help of a counsellor and patients were asked to return after 3 days. However, after 3 days only 15 patients turned up. We amended the questionnaire after analyzing their responses. Time slot was again modified to NI and NNI (Nocturnal - 22:00-06:00, Non-nocturnal - 06:00, uniform itch persistent throughout the day). This was because of inability of our patients to properly demarcate the four time slots. Also, all the questions were converted to specific response type. With the revised questionnaire and only two time slots, analysis of same 10 patients after three days yielded better comprehension and uniformity of results.

*Bellamy N, Sothern R B, Campbell J. Aspects of Diurnal Rhythmicity in Pain, Stiffness, and Fatigue in Patients with Fibromyalgia. The Journal of Rheumatology. 2004; 31:2.

Questionnaire

Tick the best option that applies to you (Q1-10)

1. How frequently have you experienced itch in the last 7 days?
   - Daily
   - Alternate day
   - Weekly
   - Occasional
2. How much would you rate your peak itch intensity in the last 3 days?
   - Mild
   - Moderate
   - Severe
   - Very severe
3. Is there one particular time of the day when you experience the peak intensity of itch?
   - Yes
   - No
4. If yes, what time of the day do you experience the above worst itch/peak intensity?
   - Nocturnal- 22:00-06:00
   - Non-nocturnal - 06:00-22:00
   - Uniform itch - Same itch intensity throughout the day
5. How would you describe the localization of itch with respect to the skin lesions?
   - Restricted to the lesions
   - Present over normal appearing skin
   - Both of the above
6. How would you describe the itch sensation?
   - Stinging
   - Tickling
   - Burning
   - Other

7. What are the aggravating factors for your itch?
   - Ambient heat
   - Sweating
   - Skin dryness
   - Stress
   - Physical efforts
   - Others
   - None
8. What are the relieving factors for your itch?
   - Cold showers
   - Sleep
   - Ambient cold environment
   - Drugs
   - Others
   - None
9. Have you ever been awakened by intense itch in the last 3 days?
   - Yes
   - No
10. If yes, on an average how many times have you been awakened per night by intense itch in the past 3 days?
   - 1-2 times
   - 3-4 times
   - 5 or more times.

Table S1: Distribution of outcomes between CSU and CPP diagnostic groups

Outcomes	Total (*n*=255)	CSU (*n*=124)	CPP (*n*=131)	*P*
Itch severity (VAS), mean (SD)	6.4 (2.2)	6.9 (1.9)	5.9 (2.5)	<0.001
Itch grade score (PGS), mean (SD)	8.1 (2.7)	7.9 (2.5)	8.3 (2.8)	0.31
Itch grade (PGS)				0.006
Mild (0-5)	39 (15.4%)	24 (19.5%)	15 (11.5%)	
Moderate (6-11)	188 (74.0%)	93 (75.6%)	95 (72.5%)	
Severe (12-18)	27 (10.6%)	6 (4.9%)	21 (16.0%)	
Itch severity (PGS)				<0.001
Mild (1)	168 (66.1%)	110 (89.4%)	58 (44.3%)	
Moderate (3)	76 (29.9%)	12 (9.8%)	64 (48.9%)	
Severe (5)	10 (3.9%)	1 (0.8%)	9 (6.9%)	
Itch-affected sleep disturbances (PGS)				0.51
Rare (0)	122 (48.4%)	57 (46.7%)	65 (50.0%)	
Occasional (2)	70 (27.8%)	36 (29.5%)	34 (26.2%)	
Frequent (4)	58 (23.0%)	29 (23.8%)	29 (22.3%)	
Totally restless (6)	2 (0.8%)	0 (0.0%)	2 (1.5%)	
Sleep score (GSDS), mean (SD)	33.0 (12.4)	33.1 (11.2)	32.8 (13.6)	0.83
Impaired sleep	48 (18.8%)	23 (18.5%)	25 (19.1%)	0.91
QoL score, mean (SD)	9.1 (5.3)	9.2 (4.5)	9.0 (6.0)	0.74
Poor QoL	180 (70.6%)	93 (75.0%)	87 (66.4%)	0.13

SD, standard deviation

Table S2: Association of nocturnal itch with sleep scores and quality of life scores

	RC	95%CI		*P*
Sleep score				
Overall[#]	6.53	3.38	9.67	<0.001
CSU*	4.50	-0.09	9.08	0.055
CPP*	7.53	2.92	12.13	0.002
QoL score				
Overall[#]	1.00	0.58	1.41	<0.001
CSU*	1.31	0.69	1.94	<0.001
CPP*	0.76	0.18	1.34	0.01

RC, regression coefficient; CI, confidence interval ; [#]Adjusted diagnostic group, disease severity, age, gender, and occupation status;*Adjusted disease severity, age, gender, and occupation status

Table S3: Association of the severity of itch with sleep and QoL between nocturnal itch and non-nocturnal itch

	Nocturnal itch				Non-nocturnal itch			
Categorized scores	**OR**	**95% CI**		***P***	**OR**	**95% CI**		***P***
Impaired sleep								
CSU	2.57	1.18	5.57	0.017	1.17	0.83	1.66	0.373
CPP	1.57	1.10	2.24	0.013	1.88	1.17	3.02	0.009
Poor QoL								
CSU	1.65	1.03	2.65	0.038	2.48	1.63	3.77	<0.001
CPP	3.29	1.61	6.74	0.001	2.39	1.64	3.47	<0.001
Quantitative scores	**RC**	**95% CI**		***P***	**RC**	**95% CI**		***P***
Sleep score								
CSU	2.61	0.97	4.25	0.003	1.33	0.03	2.64	0.045
CPP	3.44	2.07	4.82	<0.001	2.13	1.11	3.16	<0.001
QoL score								
CSU	1.19	0.60	1.77	<0.001	1.62	1.19	2.05	<0.001
CPP	1.61	1.05	2.16	<0.001	1.63	1.25	2.00	<0.001

OR, odds ratio; RC, regression coefficient; CI, confidence interval