Sleep quality in parents with children affected by psoriasis, psoriatic arthritis or atopic dermatitis: a multicenter cross-sectional study

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Background: Psoriasis (PsO), Psoriatic arthritis (PsA), and Atopic dermatitis (AD) patients have an increased risk of sleep disorders. Although sleep disturbances are well-known among patients, caregivers' oneiric evaluation remains poorly assessed. The objective was to quantify the sleep burden of parents with affected children.

Methods: In this multicenter cross-sectional study, we enrolled sex-age matched parents with children affected by PsO, PsA, and AD. Both parents underwent the Pittsburgh Sleep Quality Index to determine their sleep quality.

Results: We enrolled a total of 90 children (age 12.36±1.83 years, 45 male and 45 female) with psoriasis (n=30, PASI 7.00±2.49), atopic dermatitis (n=30, SCORAD 33.13±10.03), and psoriatic arthritis (n=30, DAPSA 26.40±10.94). Patients' Parents (age 49.83±6.69 years, 45 male and 45 female) had a PSQI of 6.17±1.91; hence 70.0%, 73.3%, and 96.7% had a bad quality of sleep, respectively, with children suffering from atopic dermatitis, psoriasis, and psoriatic arthritis. Parents with children affected by psoriasis (6.23±2.46) or by psoriatic arthritis (6.73±1.42) had lower PSQI than the ones with

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atopic dermatitis (5.53±1.55). Interestingly, children with PsA had parents with higher risk of sleep disturbances (OR 52.25 [95%CI 1.92-1,422.66], p=0.0189), and male gender was protective (OR 0.14 [95%CI 0.02-0.86], p=0.0337).

Conclusions: The sleep quality of parents is deeply influenced by the dermatological/rheumatological disease in children but not by its duration. Thus, sleep evaluation in caregivers should be part of routine patient check-ups with PsO, PsA, and AD.

Key words: psoriasis; psoriatic arthritis; atopic dermatitis; sleep quality

Psoriasis (PsO) is a chronic, immune-mediated disorder (1) that combines autoimmunity- and auto-inflammation-related features (2, 3). From a clinical point of view, psoriasis patients present demarcated, erythematosus, infiltrated, large edges squamous plaques. From an epidemiological standpoint, it has a prevalence of 2–3% without gender preference (4-6). It is estimated that approximately 10-30% of psoriasis patients will develop psoriatic arthritis (PsA) (7).

PsO is often co-localized with different comorbidities (8-11), included but not limited to sleep disorders (12-14). For instance, PsO patients have a higher risk of developing obstructive sleep apnea (OSA) with a prevalence rate of 36.0-81.8% *versus* 23% and 49% for women and men, respectively in moderate-to-severe OSA (15) in the general population, as well as restless legs syndrome (15.1-18.0% *versus* 5.0-10.0%), whereas the burden of insomnia seems comparable with that of the general population (5.9-44.8% *versus* 10-35%) (12).

Atopic dermatitis (AD) is a chronic, relapsing dermatosis that causes a cutaneous barrier dysfunction (16-18), provoking an increased trans-epidermal water loss (TEWL), dehydration, itch, and finally inflammation (19-21). Disturbed sleep is a common complaint from both parents of children with AD and AD children. Several studies focusing on AD had considered sleep as a notable patient-reported outcome (23-29).

While it is well-established that PsO, PsA and AD patients suffer from poor sleep quality, there is a dearth of data about sleep quality in parents of children affected by psoriasis, psoriatic arthritis, and atopic dermatitis. Therefore, the present study was designed to fill in this gap of knowledge.

MATERIAL AND METHODS

Study design

This is a multicenter cross-sectional study that involved 3 Italian primary referral centers (IRCCS San Donato Milanese, IRCCS San Gallicano, IRCCS Istituto Ortopedico Galeazzi) for psoriasis, psoriatic arthritis, and atopic dermatitis. The enrollment period spaced from December 2018 to December 2019. Both patient's parents signed a consent form; for pediatric patients (> 5 years and < 18 years), data were extracted and/or collected with the signed consensus to the child's legal tutor (*Patria potestate* ownership). Both parents were enrolled, and they were sex and age-matched in the three diseases analyzed. The entire protocol followed the Helsinki Declaration and its most recent amendments; thus, it was approved by the ethical committees of each center involved.

Pediatric patient selection criteria

Psoriatic pediatric patients (<18 yoa) were screened to exclude PsA preliminarily with Psoriasis Epidemiology Screening Tool (PEST) (30) and Classification for Psoriatic Arthritis (CASPAR) (31) and after with sonography to check entheses (32) and magnetic resonance for joints involvement (33). PsO patients were included in case of Psoriasis Area Severity Index (PASI) >10 (moderate to severe), PsA pediatric patients in case of fulfilling CASPAR criteria and Disease Activity in Psoriatic Arthritis (DAPSA) $^{3}5$ points, then atopic dermatitis (AD) pediatric patients in case of SCORing Atopic Dermatitis (SCORAD) >15 (moderate to severe). All pediatric patients had to agree i) to participate to the study together their parents or legal tutors, ii) to be undertreatment and iii) to had attended every dermatological visit during the last year.

Exclusion criteria:

Patients were excluded on the basis of i) previously diagnosed sleep disorders, ii) occasionally or routinely use of sleep medications, iii) any psychiatric diagnoses, iv) recent cranial trauma, v) recent jet-lag diagnosis (34), vi) untreated, or they refuse to be treated for PsO/PsA/AD, other rheumatological or gastroenterological autoimmune or systemic inflammatory diseases beside PsO/PsA/AD, vii) drug addictions (35), vii) concurrent chronic or acute infectious diseases (hepatitis B and C, HIV, tuberculosis), viii) concurrent multiple chemical sensitivity (36), ix) they did not leave together parents.

Parents selection criteria

Parents were included if they both volunteered to participate, signed the consent form, and at the time of the study were living together with their partner and children.

Conversely, they were excluded if i) the parent was not the natural parent, ii) they did not live together with their partner, ii) they were practicing intermittent circadian fasting during the Pittsburgh Sleep Quality Index (PSQI) (37-40), iii) previously diagnosed sleep disorders, iv) occasionally or routinely use of sleep medications, v) any psychiatric diagnoses, vi) recent cranial trauma, vii) recent jet-lag diagnosis, viii) no signing the consent form.

Clinical measurements

During the dermatological examination, the degree of psoriasis, psoriatic arthritis, and atopic dermatitis severity were determined using the PASI, the DAPSA, and SCORAD scores, respectively.

DAPSA is a composite indicator that takes into account several parameters, including clinical symptoms (tender and swollen joints), laboratory findings (C-reactive protein (CRP)), and patient-reported outcomes. All these measurements were done by two independent board-certified dermatologists.

SCORAD takes into account the severity of atopic dermatitis, giving approximate weights of 60% to intensity and 20% each to spread and subjective signs (including insomnia or other sleep disturbances).

The measurement of sleep quality was conducted using the Pittsburgh Sleep Quality Index (PSQI). The scale comprises 19 items, assessing seven components: namely, subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunctions. Scores in each domain of sleep-quality range from 0 to 3, with the global PSQI ranging from 0 to 21. A total score equal to or greater than 5 has been considered as poor sleep quality.

Statistical analysis

Before proceeding with any statistical processing (including data handling and manipulation), figures were visually inspected to capture any potential outlier. Normality of data distribution was verified by performing the Shapiro-Wilk's test, which was preferred to other tests (including the D'Agostino-Pearson *omnibus* or the Kolmogorov-Smirnov tests) due to the small sample size employed. Continuous data were expressed as means ± standard deviation, whereas categorical parameters were computed as percentages, where appropriate. Relevant socio-demographic (age, gender) and clinical (body mass index, BMI, child's disease duration, PASI, DAPSA, SCORAD, pharmacological treatment, parent's PSQI, and parent's eventual comorbidities) information was extracted from clinical charts.

Both univariate (Student's t-test, analysis of variance, ANOVA, or their non-parametric versions in case of violation of normal data distribution, and chi-squared test) and multivariate (multivariate logistic regressions) analyses, as well as correlation analysis, were conducted to shed light on the determinants of sleep quality among parents with children affected by dermatological disorders (psoriasis, psoriatic arthritis, and atopic dermatitis).

Figures with p-values equal to or less than 0.05 were considered statistically significant. All statistical analyses were performed by means of the commercial software "Statistical Package for Social Sciences" (SPSS for Windows, version 24.0, IBM, Armonk, NY, USA). Graphs were generated utilizing the commercial software MedCalc version 18.11.3 (MedCalc Software bvba, Ostend, Belgium).

RESULTS

Ninety children were recruited (age 12.36±1.83 years, 45 male and 45 female, average duration 3.84±4.12 years), namely 30 with PsO (PASI 7.00±2.49), 30 with AD (SCORAD 33.13±10.03), and 30 with PsA (DAPSA 26.40±10.94). Clinical and therapeutic information is summarized in Table I.

Ninety parents (45 males and 45 females) had an average of 49.83±6.69 years with a BMI of 26.23±1.73. Moreover, 15 (16.7%) parents were affected by the same disease as their children. Parents' PSQI was 6.17±1.91, with 72 (80.0%) parents with children affected reporting a poor sleep quality. In greater detail, the prevalence of poor sleep quality was 70.0%, 73.3%, and 96.7% in the case of children with AD, PsO, and PsA, respectively. Further details are reported in Table I.

A significant correlation was found between parents' PSQI and children's age (r=0.21, p=0.0452). Parents with children affected by PsO or PsA had a poorer sleep quality with respect-parents with children suffering from AD (6.23±2.46 and 6.73±1.42 *vs* 5.53±1.55, p<0.001). Remarkably, the association between parents' PSQI and children's disease duration was not significant (r=-0.18, p=0.0902); conversely, the correlation between parents' PSQI and their BMI was statistically borderline (r=-0.21, p=0.0516).

At the univariate analysis, parents with PsA children displayed the poorest quality of sleep (p=0.0054) (Fig. 1); evaluating the poor sleep group, female parents had a statistically significant higher PSQI (n=42, 58.3% *versus* n=3, 16.7%, 0.0017) (Fig. 2). All other variables under study did not result statistically significant. For further details, the reader is referred to Table II.

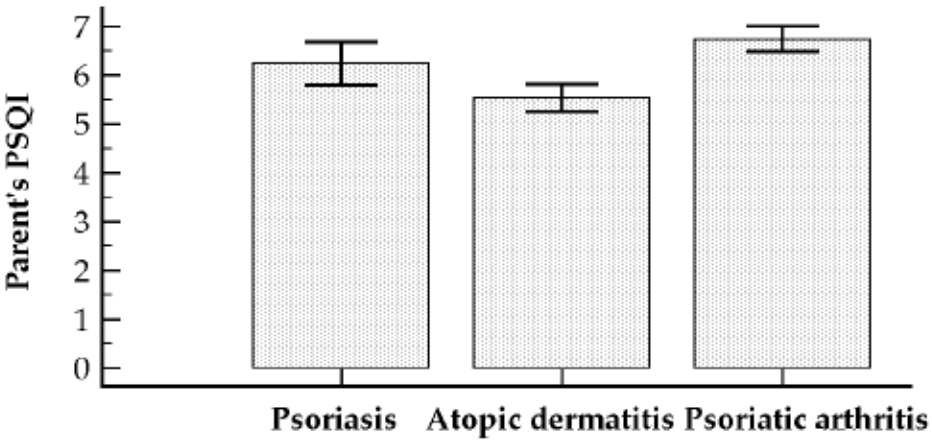

Fig. 1. *Sleep quality in parents with children affected by dermatological disorders broken down according to child's disease. PSQI: Pittsburgh Sleep Quality Index.*

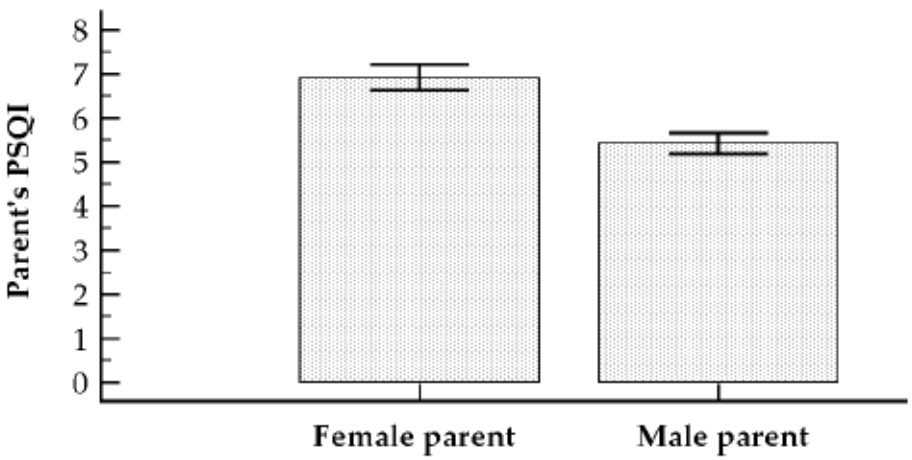

Fig. 2. *Sleep quality in parents with children affected by dermatological disorders broken down according to parent's gender. PSQI: Pittsburgh Sleep Quality Index.*

Table II. *Univariate analysis assessing differences between parents with children affected by dermatological disorders reporting poor and good sleep quality.*

Parameter	Poor sleep quality (n=72)	Good sleep quality (n=18)	Statistical significance (p-value)
Child			
Age, mean±SD, years	12.40±1.81	12.17±1.92	NS
Gender, N (%)			NS
Male	34 (47.2%)	11 (61.1%)	
Female	38 (52.8%)	7 (38.9%)	
Disease			
Disease duration	3.44±4.17	5.44±3.57	NS
Mild severity, N (%)	15 (20.8)	5 (27.8)	NS
Moderate severity, N (%)	44 (61.1%)	10 (55.6%)	NS
Severe severity, N (%)	13 (18.1%)	3 (16.7%)	NS
Psoriasis, N (%)	22 (30.6%)	8 (44.4%)	NS
PASI, means±SD	7.00±2.47	7.00±2.73	NS
Atopic dermatitis, N (%)	21 (29.2%)	9 (50.0%)	NS
SCORAD, means±SD	31.95±8.93	35.89±12.36	NS
Psoriatic arthritis, N (%)	29 (40.3)	1 (5.6)	0.0054
DAPSA, means±SD	26.14±1.04	34.00±0.00	NS
Tender joints, means±SD	3.55±1.96	3.00±0.00	NS

Swollen joints, means±SD	1.03±1.09	2.00±0.00	NS
Activity, means±SD	4.38±1.68	5.00±0.00	NS
Pain, means±SD	3.69±2.52	7.00±0.00	NS
CRP, means±SD, mg/L	13.48±7.53	17.00±0.00	NS
Pharmacological treatment			NS
Adalimumab, N (%)	19 (26.4%)	1 (5.6%)	
Cyclosporine, N (%)	3 (4.2%)	1 (5.6%)	
Dupilumab, N (%)	14 (19.4%)	4 (22.2%)	
Etanercept, N (%)	17 (23.6%)	5 (27.8%)	
Methotrexate, N (%)	7 (9.7%)	1 (5.6%)	
NB-UVB, N (%)	4 (5.6%)	4 (22.2%)	
SB4, N (%)	5 (6.9%)	1 (5.6%)	
Secukinumab, N (%)	3 (4.2%)	1 (5.6%)	
	Parent		
Age, mean±SD, years	49.58±6.45	50.83±7.68	NS
Gender, N (%)			0.0017
Male	30 (41.7%)	15 (83.3%)	
Female	42 (58.3%)	3 (16.7%)	
BMI, mean±SD,kg/m^2	26.07±1.73	26.89±1.60	NS
Affected, N (%)	11 (15.3%)	4 (22.2%)	NS

***BMI**: Body mass index; **CRP**: C-reactive protein; **DAPSA**: Disease Activity in PSoriatic Arthritis; **NB-UVB**: Narrow band ultraviolet-B; **NS**: Nonsignificant; **PASI**: Psoriasis area and severity index; **PSQI**: Pittsburgh Sleep Quality Index; **SCORAD**: SCORing Atopic Dermatitis.*

At the multivariate logistic regression analysis, having a child with PsA (OR 52.25 [95%CI 1.92-1,422.66], p=0.0189) resulted in a risk factor for poor sleep quality, whereas being a male parent (OR 0.14 [95%CI 0.02-0.86], p=0.0337) was a protective factor (Table III).

DISCUSSION

The present study showed that parents with children affected by AD or PsO or PsA had a high prevalence of poor sleep quality, especially in the case of female parents with children affected by atopic dermatitis.

Sleep disorders in a pediatric contest are usually studied at the patient level, without extending this screening to the caregivers or family members. In fact, the family is an open, highly dynamic system that is not immune to the influence of external factors, including stressors (27). Children with chronic disorders represent a major source of concerns for their caregivers and their sleep. For instance, Meltzer and Booster (28, 29) studied the sleep quality in caregivers of children with AD and asthma, finding a higher prevalence of insomnia and chronic partial sleep deprivation in these caregivers than in parents with unaffected children.

Similarly, Moore and colleagues (41) recruited 92 parents of 55 children with moderate-to-severe atopic eczema and/or asthma. Mothers and fathers caring for AD children lose 39 and 45 minutes of sleep *per* night, respectively, independently of children's age and family composition (single-parent *versus* two-parent family). It is interesting to compare our findings with those of this study: while at the correlation analysis, we found an association between sleep quality and child age, with no correlation between parental PSQI and disease severity, Moore et al. (41) reported opposite trends.

Table III. *Multivariate logistic regression analysis shedding light on the co-variates associated with poor sleep quality.*

Variable	Coefficient	SE	Wald	P	OR	95% CI
Child's age	-0.03	0.24	0.02	0.8845	0.97	0.61-1.53
Male child	-0.74	0.83	0.79	0.3731	0.48	0.09-2.42
Child's disease duration	0.13	0.25	0.30	0.5857	1.14	0.71-1.85
Severity class						
Mild	REF.					
Moderate	0.71	0.83	0.73	0.3939	2.03	0.40-10.27
Severe	-1.22	1.34	0.84	0.3599	0.29	0.02-4.05
Child's disease						
Psoriasis	REF.					
Atopic dermatitis	-0.93	1.79	0.27	0.6011	0.39	0.01-13.02
Psoriatic arthritis	3.96	1.69	5.51	0.0189	52.25	1.92-1422.66
Parent's age	-0.03	0.06	0.23	0.6304	0.97	0.86-1.10
Male parent	-2.00	0.94	4.51	0.0337	0.14	0.02-0.86
Parent's BMI	-0.07	0.24	0.09	0.7649	0.93	0.58-1.49
Parent affected	-0.17	0.89	0.04	0.8465	0.84	0.15-4.80
Constant	5.75	8.14	0.50	0.4797		

***BMI**: Body mass index; **CI**: Confidence interval; **OR**: Odds ratio; **P**: Probability; **REF**: Reference.*

The impact of children disease on parental sleep has been studied for a variety of disorders, including sleep disturbances, malignancies, seizures, cystic fibrosis, respiratory disorders, or inherited metabolic diseases (42-46), among others. However, to the best of our knowledge, no study has specifically investigated the effect of dermatological disorders such as psoriasis or psoriatic arthritis on parental sleep quality.

A recent comprehensive literature review (47) has found that children and young adolescents suffering from chronic illnesses disrupt their parents' sleep in 15-86% of cases: in our study, we found that 80% of parents reported poor sleep quality. Recent findings suggest that parents of infants and toddlers with congenital heart disease report high parenting stress, poor sleep, and maladjustment similar to that reported by parents of children with cancer, obesity, and diabetes. Analyses indicate the stress-adjustment relationship is mediated by the quality of sleep. Poor sleep quality is associated with greater negative mood among those with high levels of parenting stressors. Conversely, high levels of parenting stressors were associated with larger increases in negative mood following a night of poor sleep (48).

Furthermore, sleep health has been rarely investigated from a gender perspective; most of the sample either consists of mothers only or the mothers correspond to the clear majority of the sample. A recent cross-sectional, descriptive study confirm that mothers of school-aged children with developmental disabilities experienced frequent sleep disruptions, short sleep duration, and poor sleep quality, with about one-third of these mothers' sleep interruptions being due to the sleep-related difficulties of their children with disabilities diseases (49). Existing scholarly studies show that females tend to report poorer sleep quality than males, even though polysomnography is not able to objectify this complaint (50). It is speculated that biological, physiological (hormone profile), clinical/para-physiological (pregnancy and menopause) factors may contribute, at least partially, to explain gender-related differences in sleep quality and behavior as well as sleep disturbances.

Parenting stress, with consequent sleep deprivation and circadian disruption, alters allostasis and elevates allostatic load, affecting brain and body systems. Chronic circadian disturbance and shortened sleep time are linked to higher cortisol, obesity, and temporal lobe volume reduction. Circadian rhythmicity and sleep-wake rhythms are altered in mood disorders. (51); Thus, for these motivations and in line with precision medicine, therapies should be more and more respectful to both biological signature (52,53) and patient's environment (54,55) in order to guarantee the best response with the lowest risk of therapy-related side effects (56-59). However, despite its novelty, our study is not without any limitations. The major shortcoming is given by the study design, which, being cross-sectional, does not enable to make causal inferences in a statistically robust way. Further longitudinal investigations employing larger sample sizes are, therefore, urgently needed to replicate and corroborate our findings.

This study demonstrated that PsO, PsA, and AD also affected the sleep quality of the family, and in this specific case of parents, furthermore being a female parent with a child affected by psoriatic arthritis was a risk factor for poor sleep quality; thus, these data highlight the need to introduce the screening for sleep disorders among PsO, PsA and AD patients to assess in further detail the quality of life of patients and caregivers. Interventions aimed at improving sleep quality in parents of children with dermatological disorders and, in particular, psoriatic arthritis are expected to have important effects on parental psychological mental health and, more generally speaking, well-being. Sleep interventions for patients and parents may be helpful interventions to promote adjustment to chronic stress. However, given the above-mentioned limitations, further research is needed.

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Conflict of interests:
No conflict of interest.

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