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Evaluation of Sleep Quality by Actigraphy in Women with Systemic Lupus Erythematosus (SLE)

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Abstract

Despite the small number of studies about sleep quality and its possible occurrence in SLE, it is a frequent complaint among patients. This study evaluated sleep quality using actigraphy and the Pittsburgh sleep quality index (PSQI) in 46 women with SLE and the relationship between disease activity, cumulative damage, quality of life, pain intensity, fatigue, and medication to treat the disease, as well as the influence of pain intensity (subgroups) on quality of life. The short-form 36 health survey (SF-36) assessed health related quality of life (HRQoL), the fatigue severity scale (FSS) assessed fatigue, and the visual analog scale (VAS) was used to evaluate pain intensity. The significance level was 5%. Objective and subjective measures were concordant in sleep latency. Univariate logistic regression analysis was performed using categorized VAS pain as a dependent variable, we found an association with sleep latency (actigraphy), PSQI global score, six components of the SF-36 (physical functioning, role physical or role limitations due to physical problems, bodily pain, vitality, social functioning, role emotional or role limitations due to emotional problems), and fatigue. In the final analyses, using multivariate logistic regression, the model showed that the predicting variables for HPG (high pain group) and LPG (low pain group) were sleep latency and fatigue. Perhaps we did not find associations between sleep and quality of life as other factors were more relevant, such as pain and fatigue.

Introduction

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease, characterized by the production of several autoantibodies, where an imbalance between the action of B and T lymphocytes lead to attacks on the nucleus and cell membrane [1]. Despite the unknown origins, its etiology is multifactorial, since some factors such as genetic, hormonal, environmental, and infectious can favor its appearance [2]. SLE can reach any organs and/or systems, such as skin, joints, eyes, heart, kidneys, lungs, vascular system, and central nervous system (CNS) simultaneously or sequentially, hence it can also be classified as a multisystemic disease, marked by periods of remission and exacerbation, as well as changes in laboratory tests [3,4]. The patients are mostly young women, between 20 and 30 years of age, of fertile and productive age [5].

The presence of cytokines, responsible for the inflammatory process, disease activity, the chronic use of corticosteroids that affect the sleep-wake cycle, psychological factors, and disability in valued life activities, can impair sleep quality, increase levels of pain and fatigue, and worsen depressive mood, causing work withdrawals, help to be required to perform simple tasks (such as cleaning the house), abandonment of social activities, and isolation with a consequent negative impact on perception of quality of life [1,6-14].

Despite the small number of studies on sleep quality and its possible occurrence in SLE, it is a frequent complaint among patients, related by over 50%; the methodologies are not standardized, and, furthermore, the majority of investigations are subjective [6,7,10,15]. Only two studies, used polysomnography, a gold-standard measurement [16,17], where research revealed a longer time to fall asleep (sleep latency), frequent episodes of awakenings, restlessness, and a shorter sleep duration. In recent years, researchers have chosen to use the actigraph as an auxiliary tool to study sleep habits in special populations, such as

rheumatoid arthritis (RA) [18], primary Sjögren's syndrome (pSS) [19] osteoarthritis [20], fibromyalgia [21,22], chronic back pain [23], breast cancer [24], and recently SLE [25].

Because of these findings, the primary aim of our study was to evaluate sleep quality using actigraphy in women with SLE and secondarily to determine the concordance between measurements of sleep quality and the relationship between these tools with disease activity, cumulative damage, health related quality of life, pain intensity, fatigue, and medication to treat the disease.

Methods

Participants

This cross-sectional study was approved by the local Research Ethics Committee (UNIFESP, CEP number 51425). Eighty women with SLE fulfilling the 1982 revised American College of Rheumatology (ACR) criteria [3,4], and also the SLICC new classification criteria from 2012 [26] were potentially eligible to participate in the study. The sample was aged between 18 and 69 years and those who reported sleep complaints (PSQI ≥ 5) were invited to participate in this study. The exclusion criteria

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consisted of associated rheumatic diseases, use of sleeping medication or medication that had this effect (cyclobenzaprine, antihistamines, tranquilizers, sedative hypnotics), suspected or confirmed pregnancy, and lack of interest. Thirty-four women were excluded from the study because they did not meet the inclusion criteria: nine had other associated rheumatologic conditions (06 fibromyalgia, 01 rheumatoid arthritis, 02 Sjögren's syndrome), 08 did not report sleep complaints (PSQI<5), 06 were taking sleep medication, 05 were not interested, 05 were employed and had no time to participate, and 01 patient was pregnant.

Procedure

The study began in April 2013 and ended in September 2014. All patients signed an Informed Consent Term. We collected sociodemographic and clinical data, such as age, race, education, occupation, disease duration, and medications being used at that moment. A trained researcher administered the questionnaires.

Measures

Objective sleep quality: Actigraphy [27-29] and the Pittsburgh Sleep Quality Index (PSQI) [30,31] were used to evaluate the quantitative and qualitative data about sleep quality, respectively. The actigraph is a device such a wristwatch, which evaluates the sleep-wake cycle by recording limb movements over a 15-day period. The participants were asked to push a button on the device each night when they were about to fall asleep and when they got out of bed each morning, including NAPS during the day, if they occurred (and mark these times in a sleep diary). The button needed to be pressed to mark specific times and did not start or stop recording data. The participants were requested to remove the actigraph for activities that involved water use. The information was downloaded using Motionlogger WatchWare® software, version 1.94.2.0, 2012 (Ambulatoring Monitoring Inc., Ardsley, NY, USA) and interpreted using Action-W® version 2.7, 1996-2014 Ambulatory Monitoring Inc., by the Cole-Kripke algorithm [32]. The parameters assessed included: sleep latency, the time between when the subject got into bed and fell asleep; time of wake ups after sleep onset (WASO), a measure of sleep disruption or fragmentation, defined as the total minutes of time scored as awake from the onset to the end of the sleep interval; sleep efficiency, the percentage of time that the subject is sleeping in the bed, and the total sleep time (TST) (i.e., the total time in minutes scored of the patient being asleep in their bed). The questionnaires were applied after the period that participants used the actigraph.

Subjective sleep quality: The PSQI is a self-rated questionnaire that provides an index of sleep quality for the previous month. It contains 19 different items, distributed in seven subcomponents (duration of sleep, sleep disturbance, sleep latency, daytime dysfunction, sleep efficiency, sleep quality, and use of medication). Each subcomponent is scored from 0 (better) to 3 (worse) points and results in a total range from 0 to 21, with a score ≥ 5 indicating poor sleepers and <5 good sleepers [30,31].

HR-QOL: Health-related quality of life was assessed using the Medical Outcome Study Short Form 36 Health Survey (SF-36) that consists of 36 items subdivided into eight components: physical functioning, role physical or role limitations due to physical problems, bodily pain, general health, vitality, social functioning, role-emotional or role limitations due to emotional problems, and mental health. Each component has a final score ranging from 0–100, where zero corresponds to poorer and 100 to better functional capacity and quality of life [33].

Fatigue: We used the Fatigue Severity Scale (FSS) that measures fatigue intensity over the two previous weeks, consisting of nine affirmations with scores ranging from 1-7, where 1 indicates that the subject totally disagrees with the affirmation and 7 indicates that the subject totally agrees with the affirmation. We obtained a final score through the mean of nine statements. Scores ≥ 4 indicate severe fatigue [34,35].

Pain intensity: A visual analog scale (VAS) was used to measure pain intensity, based on a straight line measured and expressed in centimeters ranging from 0-10 cm, where a higher number corresponds to a greater intensity of pain. The VAS was based on the previous week [36]. During the interview, we asked the question: "How much pain did you feel on average in the last week?"

Disease activity: The Systemic Lupus Erythematosus Disease Activity Index (SLEDAI-2K) evaluated the clinical parameters of disease activity. The scale ranges from 0-105, where 0 indicates no activity, 1-5 indicates mild activity, 6–10 indicates moderate activity, 11-19 indicates high activity, and 20+ indicates very high activity [37].

Cumulative damage: The Systemic Lupus International Collaborating Clinics/American College of Rheumatology Damage Index (SLICC/DI) assessed the cumulative damage from the disease or its sequelae in 12 organ systems (ocular, neuropsychiatric, renal, pulmonary, cardiovascular, peripheral vascular, gastrointestinal, musculoskeletal, skin, premature ovarian failure, metabolism, and neoplasm). The score of this index can range from 0-47 [38]. A rheumatologist applied both indices.

Subgroups

For the subgroup analysis, we dichotomized the SLE patients according to VAS score (0-10 cm) into a low-pain group (scores ranging from 0-4) and a high-pain group (scores ranging from 5-10) [14].

Data Analysis

Data collection was summarized using descriptive analysis, such as mean and standard deviation. For the subgroup analysis, we also used the interquartile range (IQR) value. Pearson´s correlation coefficient was used to evaluate the association between sleep quality (actigraphy and PSQI) and its predictors. It was also used to assess concordance between the sleep measurements on latency, efficiency, and total sleep time. The t-test was used to compare sleep quality and the use of medication for lupus treatment. The Mann-Whitney U test compared the subgroup variables. Regression analyses were computed to examine predictors of sleep quality and to test independent association of pain intensity with quality of life. Linear regression was performed to determine sociodemographic (age, education, occupation) and clinical variables (disease duration, pain, fatigue, use of medication) associated with each sleep quality measurement (actigraphy data and PSQI global score). This analyses is a strategy of choice, when the target is to determine the importance of a predictor variable(s) once others have already been entered into the equation [39]. The Software adopted was SPSS 2 (version 22.0) with a 5% significance level.

Results

General information: As summarized in Table 1, the sample was composed of 46 women with SLE and poor sleep quality (mean of PSQI 10.26). The age range was between 26 and 69 years with a mean of about 42.63 years, 54.35% were mixed race, 58.7% had started or completed middle school, and overall only 21.74% were employed. The mean of disease duration was 9.66 ± 7.02 years, with mild mean values

of disease activity and little cumulative damage, SLEDAI-2K about 5.10 and SLICC/DI 0.80, respectively.

Overall, 65.22% of the sample had been taking prednisolone for at least 3 months, up to 10 mg/day; 60.87% antimalarial drugs (for the same period of the disease duration), the majority hydroxychloroquine (400 mg/day), and 69.56% was taking immunosuppressives, described in Table 1.

Regarding objective data about sleep, actigraphy revealed a longer mean time to fall asleep (sleep latency) of 33.86 min, compared to the general population, a mean awake duration after sleep onset of 39.01 min., a total sleep time of approximately 6.39 hours, and poor sleep quality with a mean PSQI of 10.26. Regarding health related quality of life, the lowest mean score in physical components such as role physical (or role limitations due to physical problems) was 35.33, followed by general health (mean 43.04), and bodily pain (mean 43.85). In these domains, the higher the score, the better the quality of life.

According to measurements of fatigue and pain, the results were high, with a mean and standard deviation of the fatigue severity scale of 4.11 ± 1.66 and a VAS mean above 5 cm (5.48 ± 2.63).

Table 2 exhibits data from the Pearson's correlation test relating to actigraphy data with the same PSQI domains in order to assess the consistency between both assessment methods. Two of the 46 patients did not use the actigraph correctly; therefore, data from 44 patients were included in the analysis. The WASO were not included as the PSQI did not contain this parameter separately. Of the three parameters, the only positive association was observed between sleep latency, with r=0.373 and p=0.013.

Correlations between sleep quality and its predictors: As shown in Table 3, correlations between the PSQI global score and its predictors, we did not find any association between poor sleep quality, disease activity (SLEDAI-2K), or cumulative damage (SLICC/DI). In health related quality of life, of the eight domains, we found a strong association between role emotional and higher sleep latency (r=-0.418, p=0.005), longer awakenings after sleep onset (r=-0.314, p=0.038), lower sleep efficiency (r= 0.302, p=0.046), and a strong association between PSQI global score (r=-0.398, p=0.006). In the other domains, we found positive associations only between poor sleep quality, role physical (r=-0.351, p=0.017), and mental health (r=-0.313, p=0.034).

Regarding fatigue score (FSS) and pain (VAS), the only association was between PSQI global score (p=0.048 and p=0.028, respectively). We did not find a relation between actigraphy data.

Use of medication to treat disease: We used the t-test to compare the PSQI global score and actigraphy parameters using dichotomous variables analysis (use of medication: yes or no), shown in Table 4. Patients who were not taking prednisolone presented a mean sleep duration of 408 min. (6.08 hours); on the other hand, those taking the medication exhibited a mean of 371 min (6.01 hours). This difference, which was nearly significant (p=0.056), indicated that patients using corticosteroids tend to experience shorter sleep duration. The only association that we observed was between the use of antimalarials and greater time to fall asleep (sleep latency), with a mean of 39.3 min.; patients that did not use these medications had a latency mean of 26 min. (p=0.032). We did not observe any association between immunosuppressives and sleep quality alterations. However, the patients that were taking this medication experienced more mean wake ups (WASO=43.7 min.) than those who were not. Rituximab was not included in the analysis as only one patient was using it.

Characteristics/Variables	n (%) or mean ± SD
Age, in years: mean ± SD	42.63 ± 10.1
Ethnicity: n (%)	
White	18 (39.13)
African	3 (6.52)
Mixed	25 (54.35)
Education: n (%)	
Some or completed elementary school	16 (34.8)
Some or completed middle school	27 (58.7)
Some or completed college	3 (6.5)
Occupation: n (%)	
Employed	10 (21.74)
On sick leave	6 (13.04)
Retired	8 (17.39)
Unemployed	22 (47.83)
Disease duration, in years: mean ± SD	9.66 ± 7.02
Disease activity (SLEDAI-2K)	5.10 ± 3.35
Cumulative Damage (SLICC/DI)	0.80 ± 1.27
Use of medication: n (%)	
Corticosteroids	30 (65.22)
Prednisolone (until 10 mg/day)	19
Prednisolone (until 15 mg/day)	1
Prednisolone (until 20 mg/day)	10
Antimalarials	28 (60.87)
Cloroquine diphosphate (250 mg/day)	4
Hydroxychloroquine (400 mg/day)	24
Immunossupressives	31
Azathioprine	11
Mycophenolate Mofetil	10
Methotrexate	9
Thalidomide	1
Cyclophosphamide	1
Immunobiologicals	
Rituximab	1 (2.17)
Actigraphy parameters	
Sleep latency1, 2	33.86 ± 21.17
WASO3	39.01 ± 24.26
Sleep eficciency4	91.35 ± 5.36
Total sleep time5	383.72 ± 61.48
Pittsburgh Sleep Quality Index	10.26 ± 3.24
Quality of life domains (SF-36)	
Physical Functioning	62.28 ± 24.17
Role Physical	35.33 ± 37.48
Bodily Pain	43.85 ± 22.35
General Health	43.04 ± 21.00
Vitality	53.26 ± 18.57
Social Functioning	63.08 ± 19.37
Role Emotional	55.08 ± 41.11
Mental Health	63.39 ± 18.38
Fatigue Severity Scale	4.11 ± 1.66
Fatigue (VAS) (cm)	6.08 ± 2.48
Pain (VAS) (cm)	5.48 ± 2.63

SLE: Systemic Lupus Erythematosus; SD: Standard Deviation; 1: Time to fall asleep; 2:normal value for a health adult of 15-20 min.; WASO: Wakeups After Sleep Onset; 3:normal value 5-15 min.; 4: normal value 85-90%; 5: normal value 6-8 hours; SF-36: Short-Form 36 health survey; VAS: Visual Analog Scale; SLEDAI-2K: Systemic Lupus Erythematosus Disease Activity Index; SLICC/DI: Systemic Lupus International Collaborating Clinics Damage Index.

Table 1: Descriptive analysis of demographic, clinical characteristics and scores of the 46 women with SLE.

Variables	r	p-value
Sleep latency	0.373	0.013*
Sleep efficiency	-0.134	0.385
Total sleep time	-0.172	0.573

PSQI: Pittsburgh Sleep Quality Index; r: Pearson´s correlation test; *Significant correlation (p <0.05) between actigraphy and respective PSQI domains.

Table 2: Correlation between actigraphy and respective PSQI domains.

Variables	ACT_SL	ACT_WASO	ACT_SE	ACT_TST	PSQI
Disease activity (SLEDAI-2K)	–	-	-	-	-
Cumulative Damage (SLICC/DI)	-	-	-	-	-
Quality of life domains (SF-36)	-	-	-	-	-
Physical Functioning	-	-	-	-	-
Role Physical	-	-	-	-	r=0.351
	-	-	-	-	p=0.017
Bodily Pain	-	-	-	-	-
General Health	-	-	-	-	-
Vitality	-	-	-	-	-
Social Functioning	-	-	-	-	-
Role Emotional	r=0.418	r=-0.314	r=0.302	-	r=-0.398
	p=0.005	p=0.038	p=0.046	-	p=0.006
Mental Health	-	-	-	-	r=-0.313
	-	-	-	-	p=0.034
Fatigue (FSS)	-	-	-	-	r=0.294
	-	-	-	-	p=0.048
Pain (VAS)	-	-	-	-	r=0.325
	-	-	-	-	p=0.028

ACT: Actigraphy; SL: Sleep Latency, WASO: Wakeups After Sleep Onset; SE: Sleep Efficiency; TST: Total Sleep Time; PSQI: Pittsburgh Sleep Quality Index; SLEDAI-2K: Systemic Lupus Erythematosus Disease Activity Index; SLICC/DI: Systemic Lupus International Collaborating Clinics Damage Index; FSS: Fatigue Severity Scale; VAS: Visual Analog Scale; r: Pearson´s correlation test; p: significance level of correlation between sleep quality and predictors.

Table 3: Correlation between sleep quality and its predictors (n=46).

Sleep quality measurement	Class of medication	YES[1] mean ± SD	NO[2] mean ± SD	p-value[3]
Actigraphy				
Sleep duration	Prednisolone	371.0 ± 60.4	408.2 ± 57.9	0.056
Sleep latency	Antimalarials	39.3 ±22.2	26.0 ± 17.2	**0.032[ł]**

1: Data from the patients who was taking a certain class of medication; 2: Data from the patients who was not taking a certain class of medication; 3: Significance level after compare patients who was and who was not taking a certain class of medication (T test); ł: Significant correlation (p<0.05) between the sleep latency measured by actigraphy and use of antimalarials.

Table 4: Comparison between actigraphy variables and the use of medication (n=44).

Descriptive analysis and comparisons between subgroups: Table 5 presents the descriptive and comparative analysis data between the subgroup variables, divided according to pain intensity into a low pain group (VAS ≤ 4) and high pain group (VAS>4). In terms of disease activity and cumulative damage, there were no relations between them, without statistical significance.

In terms of actigraphy, the mean time to fall asleep (sleep latency) in the high pain group (HPG) was almost double that in the low pain group (LPG) (38.86 *vs.* 21.92 min.), with p = 0.010. Indeed, the PSQI global score was also higher in patients with high pain (mean = 11.03 *vs.* 8.30), with the same significance value (p=0.010). Of the eight health-related quality of life domains, the subgroups exhibited significant differences in six of them: physical functioning, role physical (role limitations due to physical problems), bodily pain, vitality, social functioning, and role emotional (role limitations due to emotional problems). The higher the intensity of pain, the poorer the perception of quality of life. The subgroups exhibited significant differences in the fatigue severity scale, the mean of the HPG was 41.33 *vs.* 25.92 points (p=0.003).

Regression analyses: After performing comparative analysis, we carried out linear regressions and did not find significant relations between demographic aspects (age, education, occupation, disease duration) and sleep quality. Performing univariate logistic regression analysis using categorized VAS pain as a dependent variable, we found an association with the variables shown in (Table 6): sleep latency (actigraphy), PSQI global score, six components of the SF-36 (physical functioning, role physical or role limitations due to physical problems, bodily pain, vitality, social functioning, role emotional or role limitations due to emotional problems), and fatigue (FSS). In the final analyses, described in (Table 7), using multivariate logistic regression, the model showed the predicting variables for HPG and LPG as being sleep latency (OR=1.120, p=0.030) and fatigue (FSS) (OR=4.688, p=0.005), where each unit of increase in FSS score, increased the chance of the individual belonging to the HPG 4.688 times.

Discussion

Variables	HPG (n=33)	LPG (n=13)	p-value[ł]
SLEDAI, mean ± SD (IQR)	5.60 ± 3.74 (3.00-6.00)	3.84 ±1.51 (2.0-5.0)	0.079
SLICC, mean ± SD (IQR)	0.84 ± 1.39 (0.00-1.00)	0.69 ± 0.94 (0.0-1.0)	0.823
Actigraphy			
Sleep latency (min.), mean ± SD (IQR)	38.86 ± 22.15 (18.7-52.7)	21.92 ±12.65 (13.0-29.1)	0.01
WASO (min.), mean ± SD (IQR)	39.75 ± 26.30 (17.6-58.4)	37.26 ± 19.38 (23.0-53.0)	0.87
Sleep eficciency (%), mean ± SD (IQR)	91.16 ± 5.70 (87.6-95.7)	91.82 ± 4.64 (87.6-95.5)	0.84
Total sleep time (min.), mean ± SD (IQR)	379.70 ± 62.40 (345.0-404.0)	393.4 ± 60.4 (341.2-445.1)	0.45
PSQI, mean ± SD (IQR)	11.03 ± 3.00 (9.0-13.5)	8.30 ± 3.11 (5.5-11.0)	0.01
Quality of life domains(SF-36)			
Physical Functioning, mean ± SD (IQR)	55.45 ± 22.99 (42.5-75.0)	79.62 ±18.08 (75.0-92.5)	<0.001
Role Physical, mean ± SD (IQR)	23.48 ± 31.21 (0 - 50.0)	65.40 ± 36.10 (25.0-100)	<0.001
Bodily Pain, mean ± SD (IQR)	38.64 ± 19.49 (22.0-51.5)	57.08 ± 24.40 (41.0-73.0)	0.01
General Health, mean ± SD (IQR)	40.52 ± 23.15 (26.0-52.0)	49.46 ± 12.74 (38.5-59.5)	0.09
Vitality, mean ± SD (IQR)	49.85 ± 19.14 (32.5-65.0)	61.92 ± 14.22 (47.5-75.0)	0.03
Social Functioning, mean ± SD (IQR)	56.83 ± 16.57 (50.0-69.0)	78.92 ± 17.20 (75.0-94.0)	<0.001
Role Emotional, mean ± SD (IQR)	41.41 ± 39.11 (0 - 66.6)	89.77 ± 20.98 (83.5-100)	<0.001
Mental Health, mean ± SD (IQR)	59.88 ± 19.61 (40.0-76.0)	72.31 ± 11.01 (62.0-80.0)	0.06
Fatigue Severity Scale, mean ± SD (IQR)	4.59 ± 1.43 (3.27-5.89)	2.88 ± 1.61 (1.72-3.72)	0.002

HPG: High Pain Group; LPG: Low Pain Group. Ł: Mann-Whitney Test; SLEDAI-2K: Systemic Lupus Erythematosus Disease Activity Index; SLICC/DI: Systemic Lupus International Collaborating Clinics Damage Index; WASO: Wakeups After Sleep Onset; PSQI: Pittsburgh Sleep Quality Index; VAS: Visual Analog Scale.

Table 5: Descriptive analysis and comparisons between the subgroup variables.

Variables	β	S.E	p-value
Sleep latency (actigraphy)	0.055	0.025	0.027
Pittsburgh sleep quality index (PSQI)	0.313	0.130	0.016
Physical functioning (SF-36)	-0.073	0.028	0.008
Role physical (SF-36)	-0.033	0.011	0.002
Bodily pain (SF-36)	-0.045	0.019	0.020
Social Functioning (SF-36)	-0.078	0.026	0.003
Role emotional (SF-36)	-0.044	0.015	0.003
Mental health (SF-36)	-0.043	0.022	0.047
Fatigue severity scale (FSS)	0.768	0.270	0.004

SE: Standard Error. After performing the univariate analysis, we found that the patients who were in HPG had worsen results with significant values in sleep latency (actigraphy), sleep quality (PSQI), six domains of the SF-36 about quality of life and fatigue (FSS).

Table 6: Univariate logistic regression analysis predicting low pain group and high pain group.

Variables	β	S.E.	p-value
Sleep latency (actigraphy)	0.124	0.048	0.009
Fatigue severity scale (FSS)	1.545	0.546	0.005

SE: Standard Error, OR: Odds Ratio. After performed a multivariate model with all of variables that were significant in the univariate analysis, we obtained the above model, that is, in the presence of the other variables, the significant predictors for HPG and LPG are sleep latency and fatigue, according fatigue severity scale (FSS).

Table 7: Final multivariate logistic regression model with significant variables in univariate analysis.

This work presents new research in the field of SLE. The majority of studies on sleep quality in these patients have relied on subjective assessment tools. Two studies [16,17] used polysomnography (PSG), the gold-standard tool used to diagnose sleep disorders. However, in some cases, it is not feasible to use PSG due to its high cost and the necessity for specific laboratories in which patients sleep one or more nights, which disrupts the usual sleep routine [27,29]. On the other hand, actigraphy provides quantitative information and allows patients to maintain their usual sleep routine. A very recent study with SLE patients and actigraphy by Baldera-Díaz et al., [25], used actigraphy and mHealth systems for objective analyses of sleep quality. Their sample included nine SLE women who exhibited poor sleep quality, and more pain intensity, fatigue, and depression than the healthy controls, but they did not found significant differences in measures of actigraphy. We found differences between objective and subjective measures only in sleep latency, maybe because, according to Liu et al. [24], measures of actigraphy are closer to PSG than PSQI (i.e., objective data resemble other objectives, on the other hand, subjective data resembles other tools with the same characteristics). Landry et al. [40] suggested that the temporal difference between PSQI and actigraphy might explain their discrepancies, but a stronger contribution in relation to the distinction between subjective versus objective methods. Although the mean of total sleep time was <7 h, there was no significant relation between actigraphy and PSQI for this variable. Actigraphy provides indirect assessment of sleep using algorithms and automatic scoring methods to distinguish sleep from wakefulness [41]. Also, to Sadeh [42], in special populations, actigraphy tends to underestimate sleep latency and total sleep time, due to its lower specificity. Morgenthaler et al. [28], after compared PSG to actigraphy, found to be valid and reliable for detecting sleep in patients suspected of certain sleep disorders. Although our study was cross-sectional, the participants used the actigraph for 15 days, a long period of data collection regarding sleep patterns, as

according to Sadeh [42], five days or longer of monitoring, reduces inherent measurement errors and increases its reliability. Besides this, according to Inoue et al. [7] fluctuations in sleep patterns can occur. Their study found an association of pain as a predictor of poor sleep quality, while in the present study, pain was related to worsening quality of life.

Data analysis showed that poor sleep presented little interference in the quality of life of patients with SLE, however we could perceive the influence of pain intensity, that is, the greater the intensity of pain in SLE patients, the longer the time spent to fall asleep, and the worse the perception of quality of life and fatigue, as when we divided the sample into subgroups (HPG and LPG), as did Waldheim et al. [14], there were indications that perhaps the increase in pain intensity caused by the disease interfered in sleep quality. The increase in sleep latency has also been observed in other studies [10,43], although only subjective evaluation tools were used for assessing sleep quality, such as PSQI, and higher scores and greater fatigue intensity worsened the perception of quality of life [12]. In the present study a cause-effect relationship of this cannot be established, due to the cross-sectional nature and small sample, but we may hypothesize that high pain intensity has a role in perception of quality of life and indirectly in sleep quality, as indicated in a recent study of [44].

In relation to disease activity and cumulative damage, probably there was no relationship because as in the study of Waldheim et al. [14], the sample showed low activity and little cumulative damage. The difference in the use of antimalarials for disease treatment was not maintained after univariate regression.

According to Menefee et al. [45], the SF-36 is a commonly used and good method to measure quality of life. In that study, higher pain intensity was also associated with poor sleep quality, longer sleep latency, and lower physical functioning to perform physical tasks such as walking. According to the authors, a sedentary lifestyle has also been associated with higher sleep disturbances. In our study, other domains related to the physical component were also negatively influenced by pain intensity (role physical, bodily pain, and vitality) [14] found an association between greater pain intensity and all SF-36 domains, fatigue, depression, anxiety, and increasing disease activity, and drew attention to the anxiety that was worse in those who knew little about the disease and its evolution. The researchers also suggested that patients with higher levels of pain and fatigue would be more likely to develop fibromyalgia. However, due to the complex nature of complaints from lupus patients such as arthralgias and myalgias, more detailed investigations on the type of pain are necessary, since it is difficult to distinguish the pain caused by lupus from other pain. As in that study, we also included women because of the elevated prevalence of the disease among females, due to genetic and hormonal origins.

In Mirbahgher et al. [9], anxiety was associated with sleep latency and sleep quality (PSQI). Indeed there was an association with pain, but not with fatigue. According to Vina et al. [43,46], the trend of performing less physical activity and taking PSL affects negatively the global sleep quality in patients with SLE; prednisolone use was reported to be associated with daytime somnolence. Although we did not analyze this variable separately, our sample with high levels of pain marked a significant value on the fatigue scale that was closely related to daytime somnolence.

Although we did not analyze anxiety and depression separately, we can see in the univariate analysis of the subgroups that the HPG obtained worse scores in the mental components, such as role emotional, social

functioning, and vitality, almost achieving significance, than the LPG, although this difference was not maintained after logistic regression.

In the recent study of Inoue [7], the participants who had lower levels of pain tended also to present better sleep quality, as in the present study. Although our study was directed to self reported fatigue and we did not assess physical activity directly, Huang et al., 2007, found a positive relation with sedentary lifestyle and worse fatigue and pain; at the same time, low levels of disease activity, in other words, fatigue and pain are not always associated with the disease, but also with lifestyle and psychological factors. Even Huang et al. [47], although sleep complaints were present (72% related), they were not a predictive factor for worsening quality of life, unlike pain. Mckinley et al. [48] found higher sleep latency, although SLE patients attempted to get "enough" rest and sleep in an attempt to control fatigue and other symptoms. Therefore, fatigue is more important than quality of sleep. SLE patients tend to have problems adapting and probably require information and guidance about adaptation to enhance their ability to confront the disease, exercise safety, spiritual growth, and interpersonal relationships. In research of Mok et al. [49], achieving better control to reduce fatigue is effective in enhancing work capability, including patient perspectives for a more comprehensive assessment of SLE patients. According to Danoff-Burg et al. [50], fatigue was one of the important unmet needs in patients with SLE, due to the impact of fatigue on functional aspects, role physical, work (only 21.74% of our sample was employed, although our analyses with occupation did not reach significant values), social life, and, consequently, quality of life. In our study, it is probable fatigue is closer to higher levels of pain.

It is possible we did not find associations between sleep and quality of life because the sample in its totality already presented poor sleep quality, thus, other factors were more relevant, such as pain and fatigue. It should be recalled that one of the inclusion criteria of the study was not to have a diagnosis of fibromyalgia, as it is a disease that presents bias, with high rates of pain, fatigue and sleep alteration and could influence the objective of our study, even though the sample did not use sleep medication or muscle relaxants, despite higher levels of pain. According to Iaboni´s study [16], for patients with SLE, the lack of understanding by others leads to social isolation, negatively affecting personal and professional interactions, for example; in that study 48.2% of the sample reported some level of unmet needs related to maintaining relationships.

Our study had some limitations, it is therefore very important to conduct additional investigations that include a large sample, assessments of anxiety, depression, daytime somnolence, and specific pain groups (differentiate the types of pain). It is also important to use PSG to diagnose specific sleep disorders, make comparisons with other rheumatologic diseases, and include a healthy control group, besides the continuous use of subjective measurements with objective evaluations. The most important recommendation is to continue to develop studies with non-pharmacological methods that could improve the necessities of these patients, mainly caused by the chronic disease, which has been associated with a reduction in mortality in recent years, but not necessarily with improved quality of life in patients.

Conclusion

To summarize we can perceive that until this moment, the treatment strategy in SLE, has the objective of reducing exacerbation periods and increasing remission, however aspects related to quality of life are still not a priority in health centers, since patients continue to report complaints regarding this.

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