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

Lílian KCR*, Cristiane K†, Branca DBS‡, Marco TM§, Virginia FMT∥

*Physiotherapist, Master’s Student. Evidence-based Healthcare Program, Federal University of São Paulo (UNIFESP), Brazil.
†Assistant Professor. Department of Rheumatology, Federal University of São Paulo (UNIFESP), Brazil.
‡Associate Professor. Department of Sports, Federal University of Minas Gerais (UFMG), Brazil.
∥Affiliate Professor. Department of Rheumatology, Santa Casa de Misericórdia, São Paulo, Brazil.

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.

Keywords: Systemic lupus erythematosus; Sleep quality actigraphy; quality of life; pain

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

Received August 17, 2017; Accepted August 19, 2017; Published August 31, 2017


Copyright: © 2017 Lílian KCR, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
were requested to remove the actigraph for activities that involved water
specific times and did not start or stop recording data. The participants
these times in a sleep diary). The button needed to be pressed to mark
morning, including NAPS during the day, if they occurred (and mark
when they were about to fall asleep and when they got out of bed each
participants were asked to push a button on the device each night
actigraph is a device such a wristwatch, which evaluates the sleep-
quantitative and qualitative data about sleep quality, respectively. The
moment. A trained researcher administered the questionnaires.

Sociodemographic and clinical data, such as age, race, education,
opportunity, disease duration, and medications being used at that
moment. A trained researcher administered the questionnaires.

Objectives

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 as 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 Motionlog WatchWare
software, version 1.94.2.0, 2012 (Ambulatory 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 poorsleepers and <5 good sleepers
[30,31].

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 analysis 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

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].

Health-related quality of life was assessed using the
HR-QOL:

fatigue, social functioning, role-emotional
and role-physical 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].

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 wake 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.

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

<table>
<thead>
<tr>
<th>Characteristics/Variables</th>
<th>n (%) or mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, in years: mean ± SD</td>
<td>42.63 ± 10.1</td>
</tr>
<tr>
<td>Ethnicity: n (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>18 (38.13)</td>
</tr>
<tr>
<td>African</td>
<td>3 (6.52)</td>
</tr>
<tr>
<td>Mixed</td>
<td>25 (54.35)</td>
</tr>
<tr>
<td>Education: n (%)</td>
<td></td>
</tr>
<tr>
<td>Some or completed elementary school</td>
<td>16 (34.8)</td>
</tr>
<tr>
<td>Some or completed middle school</td>
<td>27 (58.7)</td>
</tr>
<tr>
<td>Some or completed college</td>
<td>3 (6.5)</td>
</tr>
<tr>
<td>Occupation: n (%)</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>10 (21.74)</td>
</tr>
<tr>
<td>On sick leave</td>
<td>6 (13.04)</td>
</tr>
<tr>
<td>Retired</td>
<td>8 (17.39)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>22 (47.83)</td>
</tr>
<tr>
<td>Disease duration, in years: mean ± SD</td>
<td>9.66 ± 7.02</td>
</tr>
<tr>
<td>Disease activity (SLEDAI-2K)</td>
<td>5.10 ± 3.35</td>
</tr>
<tr>
<td>Cumulative Damage (SLICC/DI)</td>
<td>0.80 ± 1.27</td>
</tr>
<tr>
<td>Use of medication: n (%)</td>
<td></td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>30 (65.22)</td>
</tr>
<tr>
<td>Prednisolone (until 10 mg/day)</td>
<td>19</td>
</tr>
<tr>
<td>Prednisolone (until 15 mg/day)</td>
<td>1</td>
</tr>
<tr>
<td>Prednisolone (until 20 mg/day)</td>
<td>10</td>
</tr>
<tr>
<td>Antimalarials</td>
<td>28 (60.87)</td>
</tr>
<tr>
<td>Chloroquine diphosphate (250 mg/day)</td>
<td>4</td>
</tr>
<tr>
<td>Hydroxychloroquine (400 mg/day)</td>
<td>24</td>
</tr>
<tr>
<td>Immunossuppressives</td>
<td>28 (60.87)</td>
</tr>
<tr>
<td>Azathioprine</td>
<td>10</td>
</tr>
<tr>
<td>Mycophenolate Mofetil</td>
<td>10</td>
</tr>
<tr>
<td>Methotrexate</td>
<td>9</td>
</tr>
<tr>
<td>Thalidomide</td>
<td>1</td>
</tr>
<tr>
<td>Cyclophosphamide</td>
<td>1</td>
</tr>
<tr>
<td>Immunobiologicals</td>
<td></td>
</tr>
<tr>
<td>Rituximab</td>
<td>1 (2.17)</td>
</tr>
<tr>
<td>Actigraphy parameters</td>
<td></td>
</tr>
<tr>
<td>Sleep latency1, 2</td>
<td>33.86 ± 21.17</td>
</tr>
<tr>
<td>WASO3</td>
<td>39.01 ± 24.26</td>
</tr>
<tr>
<td>Sleep efficiency4</td>
<td>91.35 ± 5.36</td>
</tr>
<tr>
<td>Total sleep time5</td>
<td>383.72 ± 61.48</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index</td>
<td>10.26 ± 3.24</td>
</tr>
</tbody>
</table>

**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   |

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 ± 22.15 vs. 18.7-57.9 min.), with p = 0.010. Indeed, the PSQI global score was also higher in patients with high pain (mean = 41.33 ± 29.02 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

Table 2: Correlation between actigraphy and respective PSQI domains.

<table>
<thead>
<tr>
<th>Variables</th>
<th>ACT_SL</th>
<th>ACT_WASO</th>
<th>ACT_SE</th>
<th>ACT_TST</th>
<th>PSQI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease activity (SLEDAI-2K)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cumulative Damage (SLICC/ DI)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quality of life domains (SF-36)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Physical Functioning</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Role Physical</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r=0.351</td>
</tr>
<tr>
<td>Bodily Pain</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>p=0.017</td>
</tr>
<tr>
<td>General Health</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vitality</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Social Functioning</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Role Emotional</td>
<td>r=0.418</td>
<td>r=-0.314</td>
<td>r=0.302</td>
<td>-</td>
<td>r=0.398</td>
</tr>
<tr>
<td>Mental Health</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r=0.313</td>
</tr>
<tr>
<td>Fatigue (FSS)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r=0.294</td>
</tr>
<tr>
<td>Pain (VAS)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r=0.325</td>
</tr>
</tbody>
</table>

ACT: Actigraphy; SL: Sleep Latency, WASO: Wakeups After Sleep Onset; SE: Sleep Efficiency; TST: Total Sleep Time; PSQI: Pittsburgh Sleep Quality Index; SLINC/ DI: Systemic Lupus International Collaborating Clinics Damage Index; FSS: Fatigue Severity Scale; VAS: Visual Analog Scale; r: Pearson’s correlation test; *Significant correlation (p <0.05) between actigraphy and respective PSQI domains.

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

<table>
<thead>
<tr>
<th>Sleep quality measurement</th>
<th>Class of medication</th>
<th>YES1 mean ± SD</th>
<th>NO1 mean ± SD</th>
<th>p-value3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actigraphy</td>
<td>Prednisolone</td>
<td>37.1 ± 60.4</td>
<td>408.2 ± 57.9</td>
<td>0.056</td>
</tr>
<tr>
<td>Sleep duration</td>
<td>Antimalarials</td>
<td>39.3 ± 22.2</td>
<td>26.0 ± 17.2</td>
<td>0.032</td>
</tr>
</tbody>
</table>

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; 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; 1: 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).

<table>
<thead>
<tr>
<th>Variables</th>
<th>HPG (n=33)</th>
<th>LPG (n=13)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLEDAI, mean ± SD (IQR)</td>
<td>5.60 ± 3.74 (3.00-6.00)</td>
<td>3.84 ±1.51 (2.0-5.0)</td>
<td>0.079</td>
</tr>
<tr>
<td>SLICC, mean ± SD (IQR)</td>
<td>0.84 ± 1.39 (0.00-1.00)</td>
<td>0.69 ± 0.94 (0.0-1.5)</td>
<td>0.823</td>
</tr>
</tbody>
</table>

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

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-Diaz 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 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

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

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

SE: Standard Error. After performing the univariate analysis, we found that the patients who were in HPG had worse 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 7: Final multivariate logistic regression model with significant variables in univariate analysis.

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>S.E.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep latency (actigraphy)</td>
<td>0.124</td>
<td>0.048</td>
<td>0.009</td>
</tr>
<tr>
<td>Fatigue severity scale (FSS)</td>
<td>1.545</td>
<td>0.546</td>
<td>0.009</td>
</tr>
</tbody>
</table>

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).

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 Donoff-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 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.

Conflicts of interest

The authors declare that they have no conflict of interest and no financial relationships relevant to this article to disclose.

Acknowledgements

We would particularly like to thank the AFIP (Associação Fundo de Incentivo à Pesquisa) and CEPE (Centro de Estudos em Psicobiologia e Exercício), both from Brazil.

References

sleep among women with primary Sjögren’s syndrome or rheumatoid arthritis. Musculoskeletal Care 8: 157-117.


