

# EFFECT OF MOBILE BASED NURSING INSTRUCTIONS ON PAIN AND SLEEP QUALITY AMONG PATIENTS WITH SYSTEMIC LUPUS ERYTHEMATOUS

## HAMADA ABDEL NASSER IBRAHIM

Assistant Lecturer, Medical Surgical Nursing, Faculty of Nursing, Cairo University, Egypt.  
Email: hamada.9195@gmail.com, hamada.9195@cu.edu.eg.

## MANAL MOHAMED MUSTAFA

Professor, Medical Surgical Nursing, Faculty of Nursing, Cairo University, Egypt.

## HANAN AHMED AL SEBAEE

Professor, Medical Surgical Nursing, Faculty of Nursing, Cairo University, Egypt.

## HESHAM NABIH ELMAHDY

Professor of Artificial Intelligence, Faculty of Computers and Artificial Intelligence, Cairo, Egypt.

## LOBNA AHMED MAGED

Assistant Professor of Rheumatology and Rehabilitation, Faculty of Medicine, Cairo, Egypt.

### Abstract

**Background:** Systemic lupus erythematosus (SLE) is a chronic autoimmune disease characterized by fluctuating symptoms that significantly affect patients' daily functioning and quality of life. Pain and poor sleep quality are among the most prevalent and debilitating manifestations. With the growing integration of digital health technologies, mobile-based nursing instructions have emerged as a promising approach to support continuous patient education and self-management. **Aim:** To evaluate the effect of mobile-based nursing instructions on pain and sleep quality among patients with systemic lupus erythematosus. **Design:** pretest-posttest nonequivalent control group design was utilized. **Research hypotheses:** **H<sub>1</sub>:** The post total mean scores of pain intensity of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care. **H<sub>2</sub>:** The post total mean scores of sleep quality of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care. **Setting:** The current study was conducted at the Rheumatology and Rehabilitation Department at the outpatient clinics at Kaser Al-Ainy hospital, affiliated to Cairo University. **Sample:** A convenient sample of 100 Egyptian adult conscious women with a confirmed diagnosis of SLE within the last three years were included in the study along seven consecutive months. **Tools:** three tools were utilized; Demographic and Medical Data Form (DMDF), Numerical Pain Rating Scale (NPRS) and Sleep Quality Scale (SQS). **Results:** The study results revealed that there is a statistically significant improvement over time in pain intensity and sleep quality ( $p < .001$ ), particularly at the eight-week follow-up among the study group. **Conclusion:** Mobile-based nursing instructions are an effective, accessible and patient-centered approach for improving pain and sleep quality among patients with SLE. **Recommendations:** Incorporating mobile-based educational tools into standard nursing care for patient with SLE, training nurses in digital health practices and conducting future research with larger samples to generalize the study findings.

**Keywords:** Pain Intensity, Sleep Quality, Mobile Based Nursing Instructions, Systemic Lupus Erythematosus.

## 1. INTRODUCTION

Systemic Lupus Erythematosus (SLE) is a chronic autoimmune disease in which the immune system attacks its own tissue. The disease involves a complex pathogenic mechanism which is characterized by widespread affections of different body systems. It mostly affects women with the peak incidence occurs at age 20-29 years, followed by 30–39 years old. The SLE occurs ten times more often in females than males and about 90% of people living with lupus are women, also the mortality risk in females with SLE has been ranged from twofold to fivefold relative to the total number of affected patients [1], [2], [3]. The exact cause of SLE is not known, however, a person who develops SLE probably inherits the risk from one or both parents and then develops the disease when exposed to a triggers likes; over work, not enough rest, being out in the sun for a long time, infection, injury and stopping the lupus medication or risk factors that may be genetic or environmental such as solar radiation exposure, stress, sedentary behavior, being exposed to sunlight, smoking, silica dust, air pollution, pesticides, heavy metals, repeated infection, having surgery, or being pregnant and the use of certain medications [4].

Patients with SLE may experience a variety of symptoms that can affect the whole or parts of the body including pain, sleep disturbance, headache, fever, weight changes, joint pain, swelling or stiffness, skin rashes and changes in kidney function. Additionally, more than two thirds of patients with SLE suffer from emotional disorders such as feeling sad, frustrating and lack of confidence as well as lack of self-reliance [5]. These manifestations have significant impact on everyday functioning of patients, limits their abilities to perform professional duties as well as household responsibilities, physical exercise and personal activities [6]. Nevertheless, the clinical symptoms of SLE vary among affected individuals and are unpredictable with periods of remission and flares [7], [8]. Systemic lupus erythematosus is not curable; however, symptomatic treatment helps to control disease progression and inhibit further complications related to organ damage. Moreover, SLE management increased patients' survival, and prevention and managing of chronic complications. Actually, continuous education and counseling given to patients and their families, pharmacological, non-pharmacological and nursing interventions to reduce flares positively affected patients' health outcomes and increased self-efficacy as evidenced by Mohamady et al. [3]. Pharmacological management includes corticosteroids, non-steroidal anti-inflammatory drugs (NSAIDs), antimalarials, immune suppressants and monoclonal antibody [9]. Moreover, the non-pharmacological strategies that can be used by the patients to manage their disease include self-management approaches such as adequate self-care, teaching [10], [11]. Nursing management of patients with SLE aims to monitor and document disease progression, relieving pain and educating patients on the importance of medication adherence and potential side effects, in addition, assess the extent to which symptoms interfere with the patient's lifestyle and body [12], [13]. So, nurses have a significant role during periods of disease exacerbation [14]. On the other hand, the development of information communication technologies (ICTs) has led to the spread of nursing care service delivery globally and has impacted patient care as an innovative method. In effect, World Health Organization (WHO) suggested that the use of ICT is useful to support health and health-

related fields, including telehealth, telenursing, telemedicine, mobile health (mHealth), electronic medical or health records, and artificial intelligence (AI); ICT has been pivotal role in attaining overarching health priorities such as universal health coverage and sustainable development goals. Moreover, health and nursing care should be delivered to people living anywhere in the world using these technologies [15].

Smartphones can assist the health workers in undertaking screening, diagnosing, follow-up care and acting as a vehicle for continuing medical education, supporting decision system for evidence-based management, also, it can act as a tool for patient education, self-management and compliance [16]. Speaking in the same lines, Pasyar, Sam, Rivaz and Nazarinia [17], reported that smartphone-based supportive counseling and education may help people with SLE to manage their symptoms, reduce health worry, increase acceptance of impairment, promote treatment adherence and self-efficacy of the patients. Moreover, Najm, Lempp, Gossec, Berenbaum and Nikiphorou [18], authenticated that the use of mobile applications could support people taking personal responsibility for their well-being and contribute to their disease management in a more proactive way. Therefore, the aim of the current study was evaluate the effect of mobile based nursing instruction on pain and sleep quality among patients with systemic lupus erythematosus.

## **2. METHODS**

### **2.1 Aim**

The aim of the current study was to evaluate the effect of mobile based nursing instruction on pain and sleep quality among patients with systemic lupus erythematosus. To achieve the aim of the current study, the following research hypotheses were postulated:

**H<sub>1</sub>:** The post total mean scores of pain intensity of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care.

**H<sub>2</sub>:** The post total mean scores of sleep quality of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care.

### **2.2 Design**

Quasi-experimental pretest-posttest nonequivalent control group design was utilized to demonstrate causality between an intervention (mobile based nursing instruction) and the outcomes (pain and sleep quality).

### **2.3 Setting**

The current study was conducted at the outpatient clinics in the Rheumatology and Rehabilitation Department at Kasr Al Ainy University Hospital, Cairo, Egypt.

### **2.4 Participants**

Convenient sample of 100 Egyptian adult conscious women with a confirmed diagnosis of SLE within the last three years was recruited for the study along consecutive months.

The participants who fulfill the inclusion and exclusion criteria were divided equally into two groups; study group (50) and control group (50). The inclusion criteria include; (a) female patients' age from 20 to 60 years old, have and can use android mobile with high versatility, can read and write and not using other mobile applications for SLE and (b) assessed as having mild to moderate pain and poor sleep quality guided by the following tools; the Numerical Pain Rating Scale (NPRS) and Sleep Quality Scale (SQS). On the other hand, patients with problems in communication, hearing, vision, comprehension, uncontrolled chronic diseases were excluded from the study sample, also, those who develop relapse during the study time or receive any other educational program was excluded from the current study.

## 2.5 Data Collection Tools

The first tool is Demographic and Medical Data Form (DMDF) which was developed by the researchers. The second tool is the Numerical Pain Rating Scale (NPRS) which was used to investigate the severity and intensity of pain [53]. Responses are rated using 0–10 scale, with zero meaning “no pain” and 10 meaning “the worst pain imaginable [19].

The third tool is the Sleep Quality Scale (SQS) which includes 28 items that evaluate six domains of sleep quality. It includes daytime symptoms, restoration after sleep, problems initiating sleep, difficulty waking, sleep satisfaction and maintaining sleep [52]. Scoring of the scale items is achieved by using a four-point Likert-type scale where the respondents indicate how frequently they exhibit certain sleep behaviors (0 = “rarely,” 1 = “sometimes,” 2 = “often,” and 3 = “almost always”). The total score ranges from 0 to 84, with higher scores denoting more acute sleep problems. then total scores are transformed into three main categories as follow; (good sleep quality range from zero to 28, fair sleep quality range from 29 to 56 and poor sleep quality range from 57 to 84).

## 2.6 Procedure

The current study was carried out through three phases:

**Preparatory and Assessment phase:** Once the initial approval was obtained from the Research Ethics Committee from Faculty of Nursing, Cairo University (ethics code: RHDIRB2019041701) and authoritative personnel of the selected setting, the researcher interviewed individually the target population to explain the nature and purpose of the current study. The study participants who fulfill the eligibility criteria was recruited and a written informed consent was obtained from the participants who are willing to participate in the current study. Participants were divided into two group (50) each study and control groups. During this phase also and based on comprehensive review of relevant literature, the researchers consulted an expert in the field of Communications and Information Technology who developed the mobile based nursing instructions which targets how patients with SLE can manage their pain and sleep disturbance. The researcher further established baseline data from the patients in both groups using the three data collection tools before the intervention which took approximately 40 to 50 minutes. Firstly, the researchers collected the data from the patients in the control group, then from the study group to prevent group contamination.

**Implementation phase:** This phase was concerned with the implementation of mobile based nursing instruction to the study group at the specified settings, it was conducted throughout three weeks along six sessions guided by the mobile application taking into consideration, the use of a simple Arabic language that suits the participants' educational level.

During the first week, at the first session, the researchers informed the participants that the mobile application is available on iPhone operating system (IOS) and Android software. After that the researchers met every patient individually to install the developed mobile based nursing instructions that includes information regarding a) energy conservative strategies, b) sleep hygiene interventions and c) flexibility and stretching exercises in her smart phone and gave the chance for every patient individually to browse through the application to know how to use it with the researchers' guidance.

Additionally, energy conservative strategies was provided for each patient using the mobile based nursing instruction, it includes information regarding; (a) balancing work and rest throughout the day, (b) life style modifications to reduce energy expenditure, (c) proper body mechanics and using the body efficiently, (d) setting priorities, (e) using assistive devices and (f) modifying the environment, while the second session included revision regarding the previous given instructions and answering any questions in that regard. The first session ranged from 45 to 60 minutes interrupted with breaks according to patients' tolerance, while the second one ranged from 30 to 40 minutes.

During the second week, at the third session, the researchers focused upon sleep hygiene interventions like; 1) maintain a regular sleep schedule, 2) the evening and bedtime routine, 3) prepare the mind and body for sleep and 4) prepare sleeping area (guided by the mobile application); at the fourth session the researchers revised the previous intervention to assure that the patients are committed to practice it during their daily life. The third session took 30 - 45 minutes, while the fourth one ranged from 30 to 40 minutes.

During the third week, at the fifth session, the researchers included demonstration and redemonstration of the flexibility and stretching exercises guided by the mobile application which including the following four types; 1) squatting wall slide, 2) dragon, 3) push up and 4) overhead band pull preceded by warming up sets (three minutes), basic exercises set (10 – 15 minutes) and cooling sets (three minutes), it took approximately (45 – 60) minutes. However, the sixth session focused on redemonstration of the previous learned exercises which lasted for approximately (45 – 60) minutes.

All sessions were guided by the mobile application, started by a summary of the previous session and purpose of the new one. During sessions, each participant had an opportunity to ask questions and share information with the researchers. Also, the researchers followed up the patients through the phone during the intervention period to answer any other raised questions or clarify any vague or incomprehensible point and ensure the participants' ability to follow the proposed intervention.

However, the two groups were received hospital routine care as follow; regular follow up visits at the outpatient clinic for assessment of presence of any signs or symptoms. Based on the previous assessment, the physician was requested for routine laboratory tests such as complete blood count, liver functions tests or kidney functions tests and electrolyte panel, also, the medication regimen was modified based on the previous assessment and laboratory investigation as corticosteroids, immunosuppressants and biological agents; accordingly, some patients were referred to ophthalmologist for fundus examination to monitor side effects of hydroxychloroquine.

**Follow up and Evaluation Phase:** The researchers monitored pain and sleep quality among both groups three times after the intervention using the allocated tools as the following; two weeks post intervention, four weeks post intervention and eight weeks post intervention based on Frade, O'Neill, Greene, Nutter, and Cameron [20], and other studies conducted by Gavilán et al. [21] and Hashemi, Habibagahi, Abdollahpour, and Karimi [22]. Upon completion of the data collection, the researchers installed the mobile based nursing instructions for the participants in the control group to apply the principles of fairness and justice in conducting research

## 2.7 Statistical Analysis

The collected data was coded for entry into the personal computer (PC), scored, tabulated and analyzed using Statistical Package for Social Science (SPSS) program version 20 [53]. Descriptive as well as inferential statistics such as independent t test to test the hypotheses, repeated measures analysis of variance (ANOVA) were used to test the hypotheses. Also, Pearson correlation was performed to indicate relationship between study variables and Chi squared test for categorial data to compare between the two groups. The significance level of all statistical analysis was established at P value < 0.05.

## 3. RESULTS

### 3.1 Description of Participants

Table (1) present comparison between the study and control groups on demographic characteristics. As shown, there are no statistically significant differences between the two groups in terms of age, marital status, educational level, employment status and type of residence. However, there are statistically significant differences between both groups in term of income as the income among the study group was higher than that of the control group ( $\chi^2 = 5.741$ ,  $p = .031$ ). Furthermore, as demonstrated in the same table, the participants were predominantly married women in both groups with mean age of  $33.16 \pm 9$  years. Regarding the level of education, more than one-third of participants (44 % and 38% from the study and control groups, respectively) had a secondary education. On the other hand, the vast majority of participants with percentages of 92% and 86% from the study and control groups respectively were unemployed and 80.4% and 81.4% of women in the study and control groups respectively were housewives. Moreover, less than half (46%) of the study group compared to more than half (56%) of the control group live in urban areas. Additionally, the vast majority of two groups had not enough income.

Table (2) demonstrates comparison between the study and control groups on medical data. As shown, there are no statistically significant differences between the two groups in terms of illness duration, frequency of follow-up visits, frequency and timing of flare up, family history for SLE or autoimmune disease, sun exposure and smoking status. Although there are statistically significant differences between both groups regarding the presence of comorbidities ( $\chi^2 = 9.00, p = .005$ ) as it is higher among the study group, there are no statistically significant differences between them in term of the type of comorbidity ( $\chi^2 = 0.889, p = .641$ ). Moreover, the table presents that most participants among both groups have been complaining from SLE for a duration ranging from four to less than ten years with mean duration of  $9.72 \pm 5.723$  years. Also, it is clear in the same table that most participants have variable frequency of flare up less than once per month mostly in winter with once follow-up per month and admitted to the hospital once since diagnosis. The table displays also that only less than half of participants have comorbidity, commonly hypertension and the majority expose to sun.

Table (3) displays that there are no statistically significant differences between both groups regarding the results of laboratory investigations and the most commonly disturbed results are hemoglobin which is mostly low and Erythrocyte Sedimentation Rate (ESR), serum Creatinine as well as blood Urea which shows high values in both groups.

### 3.2 Tests of Hypotheses

Table (4) displays that there are no statistically significant differences in the mean pain scores between the two groups at the pre-intervention assessment ( $t = 0.291, p = .772$ ). However, after the intervention, there are statistically significant differences between both groups at two-, four- and eight-weeks post-intervention assessments ( $t = -5.751, p = .000$ ;  $t = -8.219, p = .000$ ;  $t = -17.498, p = .000$ , respectively). Therefore, the first hypothesis is supported. Table (5) shows that there are no statistically significant differences in the total mean scores of sleep quality between both groups' pre-intervention and two-weeks as well as four-weeks post intervention ( $t = 0.305, p = .761$ ;  $t = 0.305, p = .761$ ;  $t = -1.019, p = .311$ , respectively). However, there are statistically significant differences between the two groups ( $t = -11.744, p = .000$ ) in favor of the study group eight-weeks post-intervention. Therefore, the second hypothesis is supported.

**Table 1: Comparison between the Study and Control Groups regarding Demographic Characteristics (n = 100)**

Variables	Study group		Control group		$\chi^2$	p value
	No.	%	No.	%		
<b>Age/years</b>					0.287	.866
20-	20	40	18	36		
31-	20	40	20	40		
41- 53	10	20	12	24		
$\bar{X} \pm SD = 33.16 \pm 9$ years						
<b>Marital status</b>					3.572	.312
Single	17	34	12	24		
Married	31	62	38	76		
Widowed	1	2	0	0		

Divorced	1	2	0	0		
<b>Educational level</b>						
Cannot read or write	3	6	9	18	5.814	.213
Can read and write	6	12	8	16		
Basic education	8	16	9	18		
Secondary	22	44	19	38		
Bachelor	11	22	5	10		
<b>Employment status</b>						
Employed	4	8	7	14	0.338	.576
Unemployed	46	92	43	86		
<b>Type of employment<sup>a</sup></b>						
Worker	2	50	5	71.4	0.505	.248
Other	2	50	2	28.6		
<b>Non-employed<sup>b</sup></b>						
Housewife	37	80.4	35	81.4	0.013	.908
Other	9	19.6	8	18.6		
<b>Residence</b>						
Urban	27	54	22	44	1.00	.424
Rural	23	46	28	56		
<b>Income</b>						
Enough	13	26	4	8	5.741	.031*
Not enough	37	74	46	92		

<sup>a</sup> The total is different as it concerns only those who are employed in the two groups.

<sup>b</sup> The total is different as it concerns only those who are non-employed in the two groups.

\* Significant at  $p < .05$

**Table 2: Comparison between the Study and Control Groups regarding Medical Data (n = 100)**

Variables	Study group		Control group		$\chi^2$	p value
	No.	%	No.	%		
<b>Illness duration/years</b>						
4-	26	52	34	68	0.287	.866
10-	15	30	10	20		
16-	5	10	6	12		
22-27	4	8	0	0		
$\bar{X} \pm SD = 9.72 \pm 5.723$ years						
<b>Hospital admissions</b>						
Once	26	52	2	4	36.101	.00**
Twice	3	6	0	0		
Triple	20	40	48	96		
<b>Follow-up visits/month</b>						
Once	23	46	24	48	2.221	.329
Twice	6	12	2	4		
As needed	21	42	24	48		
<b>Flare up season</b>						
Winter	37	74	45	90	7.314	.063
Summer	2	4	3	6		
Spring	1	2	0	0		
Variable	10	20	2	4		
<b>Flare up frequency/month</b>						

Once	16	32	11	22	4.840	.089
Twice	3	6	0	0		
Sometimes there is not	31	62	39	78		
<b>Comorbidity</b>						
Yes	16	32	4	8	9.00	.005**
No	34	68	46	92		
<b>Type of comorbidity<sup>a</sup></b>						
Diabetes mellitus	3	18.75	0	0	0.889	.641
Hypertension	10	62.5	3	75		
Others	3	18.75	1	25		
<b>Family history</b>						
Yes	10	20	6	12	1.190	.275
No	40	80	44	88		
<b>Sun exposure</b>						
Yes	45	90	46	92	0.122	1.00
No	5	10	4	8		
<b>Smoking status</b>						
Smoker	2	4	0	0	2.041	.495
Non-smoker	48	96	50	100		

<sup>a</sup> The total is different as it concerns only those who have comorbidity in the two groups.

\*\* Significant at  $p < .01$

**Table 3: Comparison between the Study and Control Groups regarding Laboratory Results (n = 100)**

Laboratory results	Study group		Control group		$\chi^2$	p value
	No.	%	No.	%		
Hb <sup>a</sup>					0.542	.624
Low	41	82	38	76		
Normal	9	18	12	24		
TLC <sup>b</sup>					2.929	.231
Low	5	10	3	6		
Normal	39	78	45	90		
Elevated	6	12	2	4		
PLT <sup>c</sup>					3.763	.152
Low	1	2	5	10		
Normal	48	96	45	90		
Elevated	1	2	0	0		
ESR <sup>d</sup>					0.877	.483
Normal	14	28	10	20		
Elevated	36	72	40	80		
Serum creatinine					1.010	.422
Normal	20	40	25	50		
Elevated	30	60	25	50		
Blood urea					1.020	.419
Normal	19	38	24	48		
Elevated	31	62	26	52		

<sup>a</sup> Hemoglobin

<sup>b</sup> Total leukocyte count

<sup>c</sup> Platelet count

<sup>d</sup> Erythrocyte Sedimentation Rate

**Table 4: A comparison of the Mean Scores of Pain between the Study and the Control Groups at Different Times of the Study (n= 100)**

Time of assessment	Study group (n=50)	Control group (n=50)	t	p value
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
Pre-intervention	5.24 ± 1.08	5.18 ± 0.98	0.291	0.772
Two-weeks post-intervention	4.08 ± 0.94	5.16 ± 0.93	-5.751	.000**
Mean difference = -1.08				
Four-weeks post-intervention	2.94 ± 0.96	4.72 ± 1.2	-8.219	.000**
Mean difference = -1.78				
Eight-weeks post-intervention	1.3 ± 1.25	5.16 ± 0.93	-17.498	.000**
Mean difference = -3.86				

\*\* Significant at  $p < 0.01$

**Table 5: A comparison of the Total Mean Scores of Sleep Quality between the Study and the Control Groups at Different Times of the Study (n= 100)**

	Study group (n=50)	Control group (n=50)	t	p value
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
Pre-intervention	43.08 ± 6.41	42.78 ± 2.71	0.305	0.761
Two-weeks post-intervention	43.08 ± 6.41	42.78 ± 2.71	0.305	.761
Four-weeks post-intervention	41.6 ± 6.08	42.56 ± 2.72	-1.019	.311
Eight-weeks post-intervention	26.6 ± 9.86	43.36 ± 2.16	-11.744	.000**
Mean difference = -16.76				

\*\* Significant at  $p < 0.01$

Tables (6 & 7) display the comparison between both groups in terms of each domain of sleep quality which supports further the third hypothesis. Table (7) clarifies that there are no statistically significant differences pre-intervention between the two groups in the mean total scores of daytime symptoms, difficulty waking up and maintaining sleep ( $p > .05$ ) but the difference is significant in problems initiating sleep, restoration after sleep and sleep satisfaction domains at pre-intervention assessment ( $p < .05$ ). However, there are statistically significant differences at least one post-intervention measure (eight week) between the two groups in terms of all domains of sleep quality ( $p < .05$ ) except difficulty maintaining sleep no post-intervention differences ( $p > .05$ ).

**Table 6: A Comparison of the Total Mean Scores of Daytime Symptoms, Problems Initiating Sleep, Difficulty Waking and Maintaining Sleep Domains of Sleep Quality between the Study and the Control Groups at Different Times of the Study (n= 100)**

Domain/time of assessment	Study group (n=50)	Control group (n=50)	t	p value
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
Daytime symptoms				
Pre-intervention	22.02 ± 3.86	22.96 ± 1.56	-1.597	.114

Two-weeks post-intervention	22.02 ± 3.86	22.96 ± 1.56	-1.597	.114
Four-weeks post-intervention	21.06 ± 3.69	22.74 ± 1.52	-2.973	.004**
Mean difference = -1.68				
Eight-weeks post-intervention	7.76 ± 3.15	23.08 ± 1.41	-31.357	.000**
Mean difference = -15.32				
Problems initiating sleep				
Pre-intervention	8.46 ± 1.7	9.04 ± 1.05	-2.049	.043*
Mean difference = -0.58				
Two-weeks post-intervention	8.46 ± 1.7	9.04 ± 1.05	-2.049	.043*
Mean difference = -0.58				
Four-weeks post-intervention	8.14 ± 1.7	9.04 ± 1.05	-3.182	.002**
Mean difference = -0.9				
Eight-weeks post-intervention	3.58 ± 1.14	9.24 ± 1.06	-25.65	.000**
Mean difference = -5.66				
Difficulty waking				
Pre-intervention	5.8 ± 1.21	5.88 ± 0.44	-0.439	.661
Two-weeks post-intervention	5.8 ± 1.21	5.88 ± 0.44	-0.439	.661
Four-weeks post-intervention	5.68 ± 1.2	5.88 ± 0.44	-1.106	.272
Eight-weeks post-intervention	2 ± 1.16	5.9 ± 0.42	-22.365	.000**
Mean difference = -3.9				
Maintaining sleep				
Pre-intervention	4.86 ± 0.95	4.64 ± 0.83	1.237	.219
Two-weeks post-intervention	4.86 ± 0.95	4.64 ± 0.83	1.237	.219
Four-weeks post-intervention	4.78 ± 0.97	4.64 ± 0.83	0.774	.441
Eight-weeks post-intervention	4.86 ± 0.95	4.64 ± 0.83	1.237	.219
Mean difference = -3.9				

\* Significant at  $p < .05$

\*\* Significant at  $p < 0.01$

**Table 7: A Comparison of the Total Mean Scores of Restoration After Sleep and Sleep Satisfaction Domains of Sleep Quality between the Study and the Control Groups at Different Times of the Study (n= 100)**

Domain/time of assessment	Study group (n=50)	Control group (n=50)	t	p value
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
<b>Restoration after sleep</b>				
Pre-intervention	1.36 ± 1.74	0.22 ± 0.84	4.182	.000**
Mean difference = 1.14				
Two-weeks post-intervention	1.36 ± 1.74	0.22 ± 0.84	4.182	.000**
Mean difference = 1.14				
Four-weeks post-intervention	1.36 ± 1.74	0.22 ± 0.84	4.182	.000**
Mean difference = 1.14				
Eight-weeks post-intervention	6 ± 2.52	0.16 ± 0.71	15.753	.000**
Mean difference = 5.84				
<b>Sleep satisfaction</b>				
Pre-intervention	0.7 ± 1.07	0.04 ± 0.28	4.203	.000**
Mean difference = 0.66				
Two-weeks post-intervention	0.7 ± 1.07	0.04 ± 0.28	4.203	.000**

Mean difference = 0.66				
Four-weeks post-intervention	0.7 ± 1.07	0.04 ± 0.28	4.203	.000**
Mean difference = 0.66				
Eight-weeks post-intervention	5 ± 1.55	0.04 ± 0.28	22.234	.000**
Mean difference = 4.96				

\*\* Significant at  $p < 0.01$

Table (8) shows that the majority of the studied participants had moderate pain before starting the intervention (86 & 92% of the study and control groups, respectively). On the other hand, at the end of the study, more than half (58%) of participants in the study group had mild pain; while the majority of the control group (90%) still had moderate pain.

Table (9) displays that the majority of the studied participants had fair sleep quality before starting the intervention and two-weeks post-intervention with percentages of 96% and 100% of the study and control groups respectively. However, eight-weeks post-intervention, the majority of the study group (84%) had good sleep quality, but all participants in the control group still had fair sleep quality.

**Table 8: Frequency and Percentage Distributions of Severity of Pain Categories among the Study and the Control Groups at Different Times of the Study (n=100)**

Pain	Pre-intervention		Two-week post-intervention		Four-weeks post-intervention		Eight-weeks post-intervention	
	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)
No pain	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (36)	0 (0)
Mild	7 (14)	4 (8)	15 (30)	5 (10)	38 (76)	9 (18)	29 (58)	5 (10)
Moderate	43 (86)	46 (92)	35 (70)	45 (90)	12 (24)	41 (82)	3 (6)	45 (90)

**Table 9: Frequency and Percentage Distributions of Sleep Quality among the Study and the Control Groups at Different Times of the Study (n=100)**

Sleep quality	Pre-intervention		Two-week post-intervention		Four-weeks post-intervention		Eight-weeks post-intervention	
	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)	Study No. (%)	Control No. (%)
Good	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	42 (84)	0 (0)
Fair	48 (96)	50 (100)	48 (96)	50 (100)	49 (98)	50 (100)	8 (16)	50 (100)
Poor	2 (4%)	0 (0)	2 (4%)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)

#### 4. DISCUSSION

Demographically, the current study revealed that participants were predominantly married women with a mean age of  $33.16 \pm 9$  years. Being a female in middle adulthood is strongly associated with both the prevalence and exacerbation of SLE particularly during the reproductive and middle adulthood years, which is largely attributed to hormonal influences, especially estrogen that modulate immune system activity and may contribute to increased autoimmune responses [54]. In addition, the current study findings show that near half of participants required monthly follow-up visits and hospital readmissions. From the researchers' point of view, this reflects the chronic, fluctuating nature of SLE disease which aligns with recommendations for managing chronic autoimmune diseases, where regular clinical evaluation and follow up is essential for early detection and management of flare-ups, also facilitates timely medication adjustments that consequently enhances patient adherence to therapeutic regimens. Additionally, these results reinforce the value of structured and continuous care, this approach can be further enhanced through mobile-based nursing instructions, which provide timely reminders about symptom monitoring, environmental triggers and early warning signs of flares.

Regarding the first hypothesis, "The post total mean scores of pain intensity of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care". The current study found no statistically significant difference in pain intensity between the study and control groups before the intervention, suggesting that both groups were equivalent in pain levels at baseline. Following the implementation of the mobile-based nursing instructions, significant differences emerged between the two groups across all post-intervention time points. At two weeks post-intervention, the study group reported significantly lower pain scores compared with the control group ( $t = -5.751, p < .001$ ). These improvements continued and intensified at the four-week and eight-week assessments, where pain intensity further declined in the study group relative to the control group ( $t = -8.219, p < .001$ ;  $t = -17.498, p < .001$ , respectively).

These findings revealed that mobile-based nursing instructions had a significant positive impact on reducing pain intensity among patients with SLE, as demonstrated by the significant improvements observed at all post-intervention assessments. The absence of any significant difference at baseline confirms that improvements might be attributable to the intervention rather than pre-existing group differences. The progressive decline in pain scores over the two-, four and eight-week follow-up periods suggests that continuous exposure to structured mobile-based education, self-management strategies and behavioral guidance may enhance patients' ability to regulate pain, improve joint mobility, adopt consistent pain-relieving habits and support the growing evidence that digital health interventions can effectively augment traditional care by enabling continuous patient engagement, reinforcing self-care practices and improving adherence to therapeutic strategies as viewed by literature. Therefore, the current findings confirm the first hypothesis and highlight the value of technology-supported nursing interventions in improving pain-related outcomes in systemic lupus erythematosus.

These findings consistent with a randomized control trial by Tuna, Hakbilen, Yilmaz and Unver [23] titled “Determining the effect of telehealth intervention for lupus patients on pain, happiness, and life activities: A randomized controlled study”, which found that a weekly 12-week telehealth intervention significantly reduced pain in the experimental group at week-12 compared with control and shows that remote nurse-led or telehealth-led intervention can reduce pain in systemic lupus erythematosus. Likewise, systematic review by Shi and Sit [24] covering many chronic pain populations found that mobile applications consistently reduced pain intensity, improved adherence and were feasible/acceptable, supporting the general efficacy of mHealth tools for pain management, supporting the theoretical basis of the current study regarding the mobile application. In addition to, scoping review by El Aoufy et al. [25] titled “Evidence for telemedicine heterogeneity in rheumatic and musculoskeletal diseases care: A scoping review” found that many telehealth studies in rheumatic disease measured pain among patient-reported outcomes and that telehealth interventions are increasingly used for managing pain in rheumatology. Also, Hamad et al. [26] showed that nursing-led interventions improve pain, quality of life, thus mobile-based nursing instruction builds on this basis. Otherwise, pilot study by Allen et al. [31] about an internet-based pain coping skills training program for patients with SLE, found that improved pain catastrophizing and pain interference in SLE patients. So, it supports the acceptability and feasibility of telehealth in rheumatic conditions like SLE and underscores that pain is a valid target for such interventions.

Moreover, many national studies in the same context; A study by Amer et al. [27] titled “Effect of self-management guidelines on awareness, pain and disability among patients with systemic lupus erythematosus” showed that self-management educational guidelines can significantly reduce pain among patients with systemic lupus erythematosus. As well, self-management guidelines study by Sheha, Hassan, Ahmed and Sayed [28] measuring females’ awareness and pain severity revealed that significant improvement in pain interference. Furthermore, self-management instruction study by Elghareeb and Mahmoud [29] on health outcomes for patients with SLE, measuring pain severity alongside fatigue found that a highly statistically significant decrease in severe pain after instructions. Besides, nurse-led lifestyle intervention study by Elmetwaly Ahmed and Mohamed [30] showed that improved associated symptoms including pain and self-efficacy support the role of nursing-led education for pain.

Concerning the second hypothesis, “The post total mean scores of sleep quality of patients with SLE who receive mobile based nursing instructions will be different than those who receive the routine hospital care”. The current study findings indicated that mobile-based nursing instructions had a delayed but significant positive effect on sleep quality among patients with systemic lupus erythematosus. While no statistically significant differences were observed between the two groups at baseline, two-week, or four-week post-intervention assessments, a pronounced improvement emerged at eight weeks post-intervention ( $t = -11.744$ ,  $p < .001$ ), favoring the study group. This pattern can be explained from the researchers’ point of view that the benefits of mobile-based educational interventions on sleep quality require time to manifest, likely reflecting the

gradual adoption of behavioral changes such as sleep hygiene practices, energy conservation strategies and consistent adherence to relaxation or stretching exercises provided through the application.

From literature perspective, the observed improvement aligns with principles of behavior change and self-efficacy theories, which underpin mobile health interventions. By providing structured guidance, reminders and easily accessible educational content, the mobile application likely enhanced patients' knowledge, confidence and motivation to implement effective sleep hygiene strategies as showed by Carpenter et al. [32]. In addition, improvements in pain as well as fatigue also targeted by the intervention may have indirectly contributed to better sleep quality, supporting the interconnected nature of SLE symptoms and the holistic approach of the intervention. Overall, these results highlight the effectiveness of digital and mobile health interventions in improving sleep outcomes among patients with chronic autoimmune conditions as SLE, particularly when interventions are sustained over several weeks. This underscores the importance of providing sufficient duration and ongoing support in mHealth programs to achieve clinically meaningful outcomes. These finding were supported by Askri et al. [33] who conducted a cross sectional study titled "Sleep quality in patients with systemic lupus erythematosus: the role of emotional health in Tunisia" which showed that emotional health was the only independent predictor of poor sleep, this supports the idea that sleep in SLE is closely connected to psychosocial dimensions, which can be targeted by nursing education especially via mobile platforms that can include behavioral support. Also, a systematic review by Hanrop, Narupan, Praha, Phianhasin and Ruksakulpiwat [34] regarding the impact of self-management interventions on behavioral and clinical outcomes in individuals with SLE, found that self-management interventions were shown to improve sleep quality in patients with SLE, this gives empirical support for the notion that educational/self-management interventions can positively affect sleep in systemic lupus erythematosus.

Moreover, the predictors of poor sleep in SLE like fatigue or emotional health identified in the nomogram by Ma et al. [35] suggest that interventions targeting this over time may need several weeks to show effect aligning well with the current study eight-week significant effect. Additionally, the current study findings were supported by Deck et al. [36] who investigated the development of a theory-based mHealth application for fatigue management in lupus, showing that digital health interventions and self-management applications can enhance symptom control and reduce fatigue among individuals with chronic autoimmune conditions, also, the design principles and the user-centered approach can be including for sleep hygiene content, which strengthens the plausibility that a mobile application can change behavior and improve outcomes over time.

Furthermore, cross-sectional study by Ma, Yanhong, Guo and Wang [37] titled "Associations of sleep disturbances in systemic lupus erythematosus with physical and psychological outcomes: A cross-sectional latent profile analysis" found that worse sleep especially latency and subjective quality is strongly related to higher fatigue and emotional distress, it underscores how important sleep quality is in SLE and supports the idea that

an intervention that reduces fatigue and emotional distress could improve sleep over time. Besides, a study titled “Development of a mobile app (iCANSleep) to treat insomnia in cancer survivors: User-centered design study” conducted by Garland et al. [38] supported the usability of smartphone application in treating insomnia among patients with cancer. Similarly, Egyptian cross-sectional study by Elsayed, Abdelhameed and Ibrahim [39] titled “Factors associated with sleep disturbances in SLE patients: A descriptive cross-sectional study” identified that poor sleep quality is common in SLE and is significantly correlated with disease activity, providing an empirical support for targeting sleep as an outcome especially because mobile-based nursing instruction could mitigate some modifiable contributors such as self-care behaviors and symptom awareness.

In addition, a study by Faraguna et al. [40] used actigraphy along with self-reported characterization of sleep, highlights that the use of objective digital measures (actigraphy) parallels and supports the use of technology-based interventions (like mobile apps) to monitor and potentially improve sleep. In the same context, a quasi-experimental study titled “Effects of a walking exercise programme on disease activity, sleep quality, and quality of life in systemic lupus erythematosus patients” by Lin et al. [41] showed that a walking exercise program plus routine care for three months significantly improved sleep quality in SLE patients, this supports the idea that non-pharmacological behavioral interventions can improve sleep in SLE and that emphasizing behavioral components of the study application is valid. A randomized controlled trial titled “Health-related quality of life improvements in systemic lupus erythematosus derived from a digital therapeutic plus tele-health coaching intervention: Randomized controlled pilot trial” by Khan et al. [42] reported significant improvements in sleep quality among SLE patients after six to eight weeks of a web-based self-management program, which included educational modules, symptom tracking, and reminders for behavioral interventions.

In reference to sleep domains, there are no statistically significant differences were observed between the two groups at baseline in daytime symptoms, difficulty waking up, or difficulty maintaining sleep, however, significant differences were found in problems initiating sleep, restoration after sleep and sleep satisfaction. These initial disparities may reflect natural variability in sleep disturbance profiles, a phenomenon reported in recent sleep research among patients with systemic lupus erythematosus [35]. This baseline heterogeneity is consistent with pre-intervention differences in some domains. Importantly, the intervention demonstrated its effectiveness across nearly all sleep domains at post-intervention assessments, with the exception of difficulty maintaining sleep, where no significant post-intervention differences emerged. This pattern suggests that mobile-based nursing instructions are particularly effective in influencing behavioral components of sleep like initiating sleep, feeling restored and overall satisfaction domains that are most responsive to sleep hygiene education, stretching exercises, energy conservation strategies and behavioral cues provided through digital platforms. Recent researches in the same line with this mechanism as Askri et al. [33] found that sleep initiation, subjective restoration and overall sleep satisfaction are strongly associated with emotional health and daily habits rather than with disease activity alone, making them more amenable to behavioral interventions. Similarly, Deck et al. [36] reported that

mHealth tools facilitating self-monitoring, relaxation and structured nighttime routines can meaningfully improve sleep-initiation and subjective sleep-quality domains over time.

The lack of significant improvement in difficulty maintaining sleep might reflect the influence of physiological factors such as pain flares, nocturnal joint stiffness or disease-related autonomic dysregulation components that are less responsive to educational interventions and more dependent on disease activity control. Several recent rheumatology studies note that sleep maintenance is the domain least likely to improve in non-pharmacologic interventions among SLE patients [40]. Additionally, Ozer et al. [43] described that insomnia in SLE is multifaceted: “interrupted sleep (maintenance), difficulty falling asleep (initiation), early awakening,” and provides a theoretical/clinical basis for why different sleep domains (initiation, maintenance, early morning awakening) may respond differently to interventions. Still, the significant improvements across most sleep domains support the overall effectiveness of the mobile-based nursing instruction intervention and reinforce the third hypothesis. Concerning the pain level, the current finding shows that the vast majority of study participants in both groups started with predominantly moderate pain level, a marked improvement was observed among the study group following the mobile-based nursing instructions, with more than half of participants reporting mild pain by the end of the study. In contrast, pain severity among the control group remained largely unchanged, with the vast majority continuing to experience moderate pain. This pattern highlights the positive impact of structured self-management interventions delivered via mobile technology on pain outcomes in chronic autoimmune conditions like systemic lupus erythematosus. These findings are consistent with recent literature demonstrating that pain in SLE is prevalent and often moderate to severe in intensity at baseline, frequently driven by disease activity, chronic inflammation and comorbidities such as fibromyalgia [44].

Speaking in the same context, a randomized control trial by Tuna et al. [23] reported that the majority of study participants have moderate to severe pain. Furthermore, a study by Tharwat and Husain [45] investigating musculoskeletal symptoms in SLE patients and their impact on health-related quality of life, found that the almost of the study participant reported pain in different body sites. Moreover, A qualitative interview study by Waldheim, Welin, Bergman and Pettersson [46] focusing on the patient’s perspective about pain, pointed that the majority of the study participant reported moderate to severe pain, describing the pain by its multifaceted nature, exhibiting longstanding, unpredictable, migrating and various physical sensations, also, it entailed multidimensional consequences, restricting everyday life by interfering with roles and relationships and causing various emotions, including existential thoughts. As well, a quasi-experimental study in Egypt by Amer et al. [27] investigating effect of self-management guidelines on awareness, pain and disability among patients with SLE, reported that the majority of study participants reported from moderate to severe pain. In reference to sleep quality categories, the current study findings revealed that the vast majority of participants in both groups exhibited fair sleep quality before the intervention, indicating a suboptimal baseline. At two weeks post-intervention, sleep quality remained largely unchanged, with nearly almost participants still having fair sleep. However, by eight weeks post-

intervention, a marked improvement was observed about the majority of the study group achieving good sleep quality, while the control group continued to exhibit fair sleep quality. These results suggest that the mobile-based nursing instructions had a delayed yet significant impact on sleep quality, likely due to the time required for participants to adopt new behavioral strategies, such as sleep hygiene practices, energy conservation and flexibility exercises.

These findings consistent with, an Egyptian cross-sectional study by Elsayed et al. [39] who investigated factors associated with sleep disturbances in SLE patients reported that about half of the study participant experiencing poor sleep quality. Likewise, a systematic review and meta-analysis conducted by Liu, Jia, Wang, Wei and Liu [47] about mental health conditions in patients with systemic lupus erythematosus, reported that about two-thirds of the study participants have sleep disturbance. As well, Indian study conducted by Aggarwal, Handa, Upadhyaya and Gupta [48] assessing the sleep quality in systemic lupus erythematosus showed that about the majority of the study participants reported poor sleep quality. Furthermore, a study conducted by Meidan et al. [49] investigating the relation between obstructive sleep apnea and sleep quality in SLE, revealed that greater proportion of the participants had moderate to severe obstructive sleep apnea and worse sleep quality. Moreover, Palagini et al. [50] review the clinical and psychobiological data on the relationship between sleep disturbances and SLE, reported that from half to the majority of the SLE participants have sleep disturbances.

## 5. CONCLUSION AND RECOMMENDATIONS

Based on the current study findings, the mobile-based nursing instructions are assumed to be an effective intervention for improving key outcomes among patients with systemic lupus erythematosus. Participants who received the mobile-based intervention showed significant reductions in pain intensity, alongside improvements in sleep quality, compared to those who received routine hospital care. Accordingly, the mobile-based nursing instructions could be integrated into routine care to enhance symptom monitoring and patient education. Also, nursing protocols can include structured mobile interventions as part of patient care plans, especially for chronic conditions like systemic lupus erythematosus. Last but not least, duplicating the study on other chronic autoimmune disease with larger sample in different setting is recommended for generalizing the results.

## 6. LIMITATIONS

Although every effort was made to conduct this study as described in the protocol, inevitably certain limitations existed. The limitations of the study were as follows:

- The findings are limited in generalizability due to the fact that the sample was selected from a single geographical area in Egypt.
- Some during and post-intervention assessments were conducted for several patients through telephone calls as they have difficulty keeping outpatient clinic appointments.

## 7. Abbreviations

AI	Artificial Intelligence
ANOVA	Analysis of Variance
DMDF	Demographic and Medical Data Form
ESR	Erythrocyte Sedimentation Rate
ICT	Information Communication Technology
IOS	iPhone Operating System
<i>N</i>	Sample size
NSAIDs	Non-Steroidal Anti-inflammatory Drugs
No.	Number
NPRS	Numerical Pain Rating Scale
PC	Personal Computer
SLE	Systemic Lupus Erythematosus
SPSS	Statistical Package for Social Science
SQS	Sleep Quality Scale
WHO	World Health Organization

## DECLARATIONS

### Ethical Considerations

This study was part of a Doctorate thesis, approved by the Research Ethics Committee of Faculty of Nursing, Cairo University (ethics code: RHDIRB2019041701). In addition, a written informed consent was obtained from all participants after explaining the nature, purpose and significance of the study as well as the expected benefit and/or risk. It was emphasized also that participation in the study is entirely voluntary and they have the right to withdraw from the study at any point without penalty.

### Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### Competing Interests

The authors declare that they have no competing interests.

### Funding

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Acknowledgment

The authors would like to thank all the team in the Rheumatology and Rehabilitation Department at Kasr Al Ainy University Hospital and the patients who participated in this study.

## References

- 1) Xiang, W., Xia, X., Lu, Y., Zhang, X., Shi, X., Jia, X., ... & Chen, W. (2024). Sex differences in mortality among patients with lupus nephritis. *European Journal of Medical Research*, 29(1), 500.
- 2) Zen, M., Salmaso, L., Barbiellini Amidei, C., Fedeli, U., Bellio, S., Iaccarino, L., ... & Saia, M. (2023). Systemic lupus erythematosus incidence and prevalence in a large population-based study in northeastern Italy. *Rheumatology*, 62(8), 2773-2779.
- 3) Mohamady, S. H., Srour, O. A. A., & Saad, N. S. E. (2022). Effect of Self-Care management on Health Outcomes and Symptoms for Females with Systemic Lupus Erythematosus. *Tanta Scientific Nursing Journal*, 25(2), 130-151.
- 4) Refai, R. H., Hussein, M. F., Abdou, M. H., & Abou-Raya, A. N. (2023). Environmental risk factors of systemic lupus erythematosus: a case-control study. *Scientific reports*, 13(1), 10219. <https://doi.org/10.1038/s41598-023-36901-y>
- 5) Centers for Disease Control and Prevention, (2022). Systemic Lupus Erythematosus. Available at <https://www.cdc.gov/lupus/facts/detailed.html>. Accessed at 20-11-2023.
- 6) Inoue, M., Shiozawa, K., Yoshihara, R., Shima, Y., Hirano, T., & Makimoto, K. (2023). Monitoring of Sleep Indicators, Physical Activity, Pain, and Fatigue in Patients with Systemic Lupus Erythematosus and Relations among These Variables: A Pilot Study. *Open Journal of Nursing*, 13(1), 22-44.
- 7) Mary, S., Geetha, P., Sathiya, K., & Rajeswari, S. (2021). Education-based selfmanagement intervention on awareness among patients with systemic lupus erythematosus at tertiary care hospital, Chennai, India. *Journal of Clinical and Diagnostic Research*, 15(11), LC33-LC38. <https://doi.org/10.7860/JCDR/2021/49219.15671>
- 8) Xerfan, E. M., Andersen, M. L., Tomimori, J., Tufik, S., & Facina, A. S. (2021). The role of sleep in the activity of lupus erythematosus: an overview of this possible relationship. *Rheumatology*, 60(2), 483-486.
- 9) Hao, X., Wang, Y., Liu, R., Zhang, D., Kong, B., Liang, J., & Sun, L. (2023). Developing engineering technologies for the treatment of systemic lupus erythematosus. *Biomedical Technology*, 4, 1-10.
- 10) Lazar, S., & Kahlenberg, J. M. (2023). Systemic lupus erythematosus: new diagnostic and therapeutic approaches. *Annual review of medicine*, 74, 339-352.
- 11) Fanouriakis, A., Kostopoulou, M., Andersen, J., Aringer, M., Arnaud, L., Bae, S. C., ... & Boumpas, D. T. (2023). EULAR recommendations for the management of systemic lupus erythematosus: 2023 update. *Annals of the rheumatic diseases*.
- 12) El-Zayat, O. S., Elkattan, B. A., & Hassan, R. A. (2022). Effect of Telenursing Instructions on Improvement of Awareness among Systemic Lupus Erythematosus Patients. *Tanta Scientific Nursing Journal*, 27(4), 261-284.
- 13) Denisa, V., Zamira, I., Imami, L. A., Gazmira, M., & Suzana, S. (2022). Nursing Care in Patients with Systemic Lupus Erythematosus. *Norwegian Journal of Development of the International Science*, (96), 45-50.
- 14) Cano García, L., Domínguez Quesada, C., Rodríguez Vargas, A. I., Trujillo Martín, E., & Martín Martín, J. M. (2023). Nursing Recommendations in the Management of Systemic Lupus Erythematosus: A Delphi Consensus. *Hispanic Health Care International*, 15404153231176001.
- 15) Kamei, T., (2022). Telenursing and artificial intelligence for oncology nursing, *Asia Pac J Oncol Nurs*. v.9(12); 2022 Dec doi: 10.1016/j.apjon.2022.100119.

- 16) Kim Y, Lee H & Seo JM. (2022) Integrated Diabetes Self-Management Program Using Smartphone Application: A Randomized Controlled Trial. *Western Journal of Nursing Research*. Available at: <https://pubmed.ncbi.nlm.nih.gov/33655794/>.
- 17) Pasyar, N., Sam, A., Rivaz, M., & Nazarinia, M. (2023). A smartphone-based supportive counseling on health anxiety and acceptance of disability in Systemic Lupus Erythematosus patients: A randomized clinical trial. *Patient Education and Counseling*, 110, 107676.
- 18) Najm, A., Lempp, H., Gossec, L., Berenbaum, F., & Nikiphorou, E. (2020). Needs, experiences, and views of people with rheumatic and musculoskeletal diseases on self-management mobile health apps: mixed methods study. *JMIR mHealth and uHealth*, 8(4), e14351.
- 19) Harrington, S., Gilchrist, L., & Sander, A. (2014). Breast cancer EDGE task force outcomes: clinical measures of pain. *Rehabilitation oncology*, 32(1), 13.
- 20) Frade, S., O'Neill, S., Greene, D., Nutter, E., & Cameron, M. (2023). Exercise as adjunctive therapy for systemic lupus erythematosus. *Cochrane Database of Systematic Reviews*, (4).
- 21) Gavilán-Carrera, B., Vargas-Hitos, J. A., Morillas-de-Laguno, P., Rosales-Castillo, A., Sola-Rodríguez, S., Callejas-Rubio, J. L., ... & Soriano-Maldonado, A. (2022). Effects of 12-week aerobic exercise on patient-reported outcomes in women with systemic lupus erythematosus. *Disability and Rehabilitation*, 44(10), 1863-1871.
- 22) Hashemi, S., Habibagahi, Z., Abdollahpour-Alitappeh, M., & Karimi, M. H. (2022). Effects of combined aerobic and anaerobic exercise training on cytokine profiles in patients with systemic lupus erythematosus (SLE); a randomized controlled trial. *Transplant Immunology*, 70, 101516.
- 23) Tuna, H. I., Hakbilen, S., Yilmaz, S., & Unver, G. (2024). Determining the Effect of Telehealth Intervention for Lupus Patients on Pain, Happiness, and Life Activities: A Randomized Controlled Study. *Pain Management Nursing*, 25(3), 316-322.
- 24) Shi, J. L. H., & Sit, R. W. S. (2024). Impact of 25 years of mobile health tools for pain management in patients with chronic musculoskeletal pain: systematic review. *Journal of medical Internet research*, 26, e59358.
- 25) El Aoufy, K., Melis, M. R., Magi, C. E., Bellando-Randone, S., Tamburini, M., Bandini, G., ... & Rasero, L. (2024). Evidence for telemedicine heterogeneity in rheumatic and musculoskeletal diseases care: a scoping review. *Clinical Rheumatology*, 43(9), 2721-2763.
- 26) Hamad, A. H., Ragab, I. I., & Zytoon, H. K. (2024). Effect of Non-Pharmacological Nursing Interventions on Fatigue, Pain and Quality of Life for Patients with Systemic Lupus Erythematosus. *Zagazig Nursing Journal*, 20(1), 406-420.
- 27) Amer, S. A. E. M., El-Sheikh, A. A., Eldoushy, E. E., & Gad, A. M. M. (2024). Effect of Self-Management Guidelines on Awareness, Pain and Disability among Patients with Systemic Lupus Erythematosus. *Menoufia Nursing Journal*, 9(2), 347-362.
- 28) Sheha, E. A. A. E. M., Hassan, H. E., Ahmed, E. H., & Sayed, M. A. (2024). Women's Awareness Regarding Systemic Lupus Erythematosus: Impact of Self-Management Guidelines. *Assiut Scientific Nursing Journal*, 12(45), 15-29.
- 29) Elghareeb, S. M., & Mahmoud, H. M. (2022). Influence of self-management instruction on outcomes of health for systemic lupus erythematosus patients. *Egyptian Journal of Nursing and Health Sciences*, 3(1), 391-408.
- 30) Elmetwaly, R., Ahmed, A., & Mohamed, Y. (2021). Effect of nurse-led lifestyle intervention protocol on associated symptoms and self-efficacy among patients with systemic lupus erythematosus. *Egyptian Journal of Health Care*, 12(1), 814-830.

- 31) Allen, K. D., Beauchamp, T., Rini, C., Keefe, F. J., Bennell, K. L., Cleveland, R. J., ... & Sheikh, S. Z. (2021). Pilot study of an internet-based pain coping skills training program for patients with systemic Lupus Erythematosus. *BMC rheumatology*, 5(1), 20.
- 32) Carpenter, K., Gilman, S., French, M., Shakur, Y., Dunlop-Thomas, C., Cullerton, L., ... & Lim, S. S. (2024). Informing Digital Programs for Lupus Self-Management Education: A Systematic Scoping Review. *Arthritis care & research*, 76(9), 1211-1223.
- 33) Askri, F., Ben Achour, T., Said, F., Mahfoudh, K., Jridi, M., Naceur, I., ... & Jomli, R. (2025). Sleep quality in patients with systemic lupus erythematosus: The role of emotional health in Tunisia. *Lupus*, 09612033251386098.
- 34) Hanrop, S., Narupan, N., Praha, N., Phianhasin, L., & Ruksakulpiwat, S. (2025). The Impact of Self-Management Interventions on Behavioral and Clinical Outcomes in Individuals with Systemic Lupus Erythematosus: A Systematic Review of Empirical Evidence From 2003-2024. *Patient preference and adherence*, 1763-1779.
- 35) Ma, L., Li, Y. H., Guo, X., Wang, Y., Wu, Y. L., & Tan, C. Y. (2025). A nomogram for predicting poor sleep quality in patients with systemic lupus erythematosus. *Frontiers in Neurology*, 16, 1562949.
- 36) Deck, A., Singh, K., Caras, P., LeClair, A., Gore-Massy, M., Chiu, F., ... & Kasturi, S. (2025). Development of a Theory-Based mHealth App for Fatigue Management in Lupus: Human-Centered Design Approach. *JMIR Formative Research*, 9, e75399.
- 37) Ma, L., Yanhong, L., Guo, X., & Wang, Y. (2025). Associations of Sleep Disturbances in Systemic Lupus Erythematosus 1 With Physical and Psychological Outcomes: A Cross-Sectional Latent 2 ProfileAnalysis. *Frontiers in Immunology*, 16, 1626597.
- 38) Garland, S. N., Kutana, S., Piedalue, K. A., Lee, R., Rash, J., & Cerallo, G. (2025). Development of a Mobile App (iCANSleep) to Treat Insomnia in Cancer Survivors: User-Centered Design Study. *JMIR cancer*, 11(1), e74387.
- 39) Elsayed, E. E. M., Abdelhameed, Y. A., & Ibrahim, N. H. (2024). Factors Associated with Sleep Disturbances in SLE Patients: A Descriptive Cross-Sectional Study. *Egyptian Journal of Hospital Medicine*, 94(1), 733-739.
- 40) Faraguna, U., Porciani, C., Colitta, A., Bruno, S., Frumento, P., Stagnaro, C., ... & Mosca, M. (2024). Actigraphic and self-reported characterization of sleep in systemic lupus erythematosus patients. *Rheumatology*, 63(4), 1076-1083.
- 41) Lin, M. C., Livneh, H., Lu, M. C., Chang, C. H., Chen, M. L., & Tsai, T. Y. (2023). Effects of a walking exercise programme on disease activity, sleep quality, and quality of life in systemic lupus erythematosus patients. *International Journal of Nursing Practice*, 29(6), e13174.
- 42) Khan, F., Granville, N., Malkani, R., & Chathampally, Y. (2020). Health-related quality of life improvements in systemic lupus erythematosus derived from a digital therapeutic plus tele-health coaching intervention: randomized controlled pilot trial. *Journal of medical Internet research*, 22(10), e23868.
- 43) Ozer, S., Kankaya, H., Gün, R., Yeler, N., Marangoz, Ö., & Bozça, H. (2022). Factors affecting sleep quality in patients with systemic lupus erythematosus. *Lupus*, 31(1), 39-44.
- 44) Leung, J., Keller, E. P., Nietert, P., Caldwell, T., Dismuke-Greer, C. L., Johnson, H., & Williams, E. (2025). Does social support reduce bodily pain among African American women with SLE? Findings from a randomised controlled trial. *Lupus Science & Medicine*, 12(2).
- 45) Tharwat, S., & Husain, S. M. (2024). Musculoskeletal symptoms in systemic lupus erythematosus patients and their impact on health-related quality of life. *BMC Musculoskeletal Disorders*, 25(1), 272.

- 46) Waldheim, E., Welin, E., Bergman, S., & Pettersson, S. (2024). The experience and implications of pain in systemic lupus erythematosus: A qualitative interview study focusing on the patient's perspective. *Lupus*, 33(13), 1435-1445.
- 47) Liu, X., Jia, X., Wang, X., Wei, Y. B., & Liu, J. J. (2024). Mental health conditions in patients with systemic lupus erythematosus: a systematic review and meta-analysis. *Rheumatology*, 63(12), 3234-3242.
- 48) Aggarwal, A., Handa, R., Upadhyaya, S., & Gupta, S. J. (2024). Sleep Quality in Systemic Lupus Erythematosus. *Journal of Clinical Rheumatology and Immunology*, 24(supp01), 89-90.
- 49) Meidan, R., Elalouf, O., Tauman, R., Furer, V., Polachek, A., Wollman, J., ... & Paran, D. (2023). Systemic lupus erythematosus and obstructive sleep apnea: a possible association. *Life*, 13(3), 697.
- 50) Palagini, L., Tani, C., Mauri, M., Carli, L., Vagnani, S., Bombardieri, S., ... & Mosca, M. (2014). Sleep disorders and systemic lupus erythematosus. *Lupus*, 23(2), 115-123.
- 51) Yi, H., Shin, K., & Shin, C. (2006). Development of the sleep quality scale. *Journal of Sleep Research*, 15(3), 309-316.
- 52) Hartrick, C. T., Kovan, J. P., & Shapiro, S. (2003). The numeric rating scale for clinical pain measurement: a ratio measure. *Pain Practice*, 3(4), 310-316.
- 53) International Business Machines (IBM) Support. (2021). Downloading IBM SPSS Statistics 20. Retrieved 11-1-2022 from <https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-20>.
- 54) Gomes, L. L. A., Werth, A. J., Thomas, P., & Werth, V. P. (2024). The Impact of Hormones in Autoimmune Cutaneous Diseases. *The Journal of Dermatological Treatment*, 35(1), 2312241. <https://doi.org/10.1080/09546634.2024.2312241>