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Association between Immune System and Sleep Parameters Among Adults with Bronchial Asthma

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ABSTRACT

Background: Bronchial asthma characterized with inflammation and alteration of immune system activity that induce hyper-reactivity of airways. Inadequate control of associated with impaired sleep quality that adversely influence immunological functions.

Objective: This trial was to measure relation between immune system and sleep parameters among bronchial asthma patients.

Material and Methods: Forty Saudi patients with bronchial asthma consisted of 23 males and 17 females, aged 42-56 year and age matched forty healthy controls consisted of 21 males and 19 females, aged 40-58 year.

Results: The mean value of CD3, CD4, IgG, IgA, IgM, awake time after sleep onset and REM sleep latency were significantly higher in asthma group (A) compared to control group (B). In addition to a significant lower total sleep duration and sleep efficiency in asthma group (A) compared to control group (B). Moreover, CD3, CD4, IgG, IgA, IgM showed a strong inverse relationship with total sleep duration and sleep efficiency and direct relationship with awake time after sleep onset and REM sleep latency in the asthma group (A) ($P<0.05$).

Conclusion: Immune system response associated with sleep parameters among patients with bronchial asthma.

Keywords: bronchial asthma, immune system, sleep parameters

INTRODUCTION

Asthma is a conducting airway dysfunction of reversible airway obstruction and inflammation [1]. Asthma is the leading chronic respiratory diseases, which affect more than 334 million people worldwide [2]. By 2025, this number will be expected to reach greater than 100 million [3]. Approximately 500,000 annual hospitalizations are due to asthma, and 250 000 deaths annually, therefore the economic burden of asthma management is huge [4,5].

Bronchial asthma is an airway inflammatory disorder with some cells involved in immune system action on airway epithelial cells causing hyper-reactivity in the bronchial airways [6,7]. Asthmatic attacks are more common at night that disturb their sleep [8-12]. Chest tightness, difficulty of breathing, cough and wheezes are the criteria of nocturnal asthmatic attacks that disturb sleep and adversely affect the immune system performance [13-15].

Insomnia is associated with psychosocial and occupational impairments include cognitive deficits, poor mood, daytime fatigue and poor quality of life [16]. Many previous studies proved an association between sleep difficulties and immune system dysfunctions among depressed subjects [17, 18]; lower NK cell activity [19] and significantly reduced levels of immune cells [20].

This trial was to measure relation between immune system and sleep parameters among bronchial asthma patients.

SUBJECTS AND METHODS

Subjects

Forty Saudi patients with bronchial asthma consisted of 23 males and 17 females, aged 42-56 year. In addition to forty healthy subjects consisted of 21 males and 19 females, aged 40-58 year, participated in this study as a control group. Renal, cardiac, heart and hepatic failure in addition to medication affects immune system considered as exclusion criteria. All participants signed the informed written consent from. This study was approved by the Scientific Research Ethical Committee, Faculty of Applied Medical Sciences at King Abdulaziz University, Jeddah, Saudi Arabia.

Measurements

Sleep measures: All participants underwent polysomnographic (PSG) recording for assessment of sleep quality over two nights at the beginning and at the end of the study. A qualified sleep technician conducted the polysomnographic (PSG) recording using a digital sleep system (Philips-Respironics, USA) [21].

Table 1. Baseline characteristics of all participants

Variable	Asthma group (A)	Control group (B)	Significance
Age (year)	38.76 ± 5.21	39.54 ± 4.85	P>0.05
Gender (male/female)	29/11	27/13	P>0.05
BMI (kg/m^2)	25.15 ± 3.48	23.92 ± 4.16	P>0.05
Waist hip ratio	0.85 ± 0.06	0.82 ± 0.08	P>0.05
Hemoglobin (gm/dl)	12.53 ± 1.87	13.21 ± 1.64	P>0.05
SBP (mm Hg)	146.25 ± 12.73	143.13 ± 10.98	P>0.05
DBP (mm Hg)	88.13 ± 6.54	85.86 ± 5.75	P>0.05
Glucose (mg/dL)	90.45 ± 8.11	87.23 ± 7.19	P>0.05
FVC (L)	2.94 ± 1.26	3.92 ± 1.43	P<0.05
FEV_1(L)	1.91 ± 0.87	3.28 ± 0.79	P<0.05
FEV_1/FVC (%)	64.34 ± 5.98	83.12 ± 7.91	P<0.05

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FVC, forced vital capacity; FEV1, forced expiratory volume in the first second; FEV1/FVC, ratio between forced expiratory volume in the first second and forced vital capacity; (*) indicates a significant difference between the two groups, P < 0.05

Table 2. Comparison between the two groups concerning polysomnographic parameters, CD3, CD4, IgG, IgA and IgM

	Mean + SD		t- value	Significance
	Asthma group (A)	Control group (B)		
CD3 (mg/L)	943.15 ± 53.56	857.27 ± 44.21	13.36	P<0.05
CD4 (mg/L)	635.11 ± 37.63	568.71 ± 42.19	10.48	P <0.05
IgG (mg/dL)	792.13 ± 41.87	712.28 ± 32.86	9.93	P <0.05
IgA (mg/dL)	247.15 ± 30.23	192.73 ± 24.13	8.27	P<0.05
IgM (mg/dL)	191.12 ± 26.23	117.73 ± 21.58	11.23	
Total sleep duration (min)	311.71 ± 38.65	348.46 ± 42.21*	17.24	P <0.05
Sleep efficiency (%)	67.35 ± 7.41	81.24 ± 8.83*	7.42	P <0.05
Sleep onset latency (min)	10.52 ± 3.16	14.31 ± 3.45*	6.37	P <0.05
Awake time after sleep onset (min)	78.31 ± 7.59	64.52 ± 6.24*	7.83	P <0.05
REM sleep latency (min)	89.67 ± 8.12	68.23 ± 7.15*	8.96	P <0.05

REM: rapid eye movements; RSES: Rosenberg Self-Esteem Scale; BDI: Beck Depression Inventory; POMS: Profile of Mood States; (*) indicates a significant difference between the two groups, P < 0.05

Table 3. Correlation coefficient (r) of correlation between polysomnographic parameters and immune system parameters include (CD3, CD4, IgG, IgM, IgA) in the asthma group (A)

	CD3 (mg/L)	**CD4** (mg/L)	**IgG** (mg/dL)	**IgA** (mg/dL)	**IgM** (mg/dL)
Total sleep duration (min)	- 0.538*	- 0.726**	- 0.623*	- 0.651**	- 0.516*
Sleep efficiency (%)	- 0.687**	- 0.713**	- 0.595**	- 0.543*	- 0.622*
Sleep onset latency (min)	- 0.681**	- 0.624*	- 0.544*	- 0.512*	- 0.527*
Awake time after sleep onset (min)	0.626*	0.537*	0.618**	0.716**	0.538*
REM sleep latency (min)	0.675*	0.512*	0.532*	0.521*	0.672**

Spearman's correlation was used *: P < 0.05 **: P < 0.01

Analysis of peripheral blood cells: Beckman Coulter AcT 5diff hematology analyzer was used to calculate the white blood cells, neutrophils, monocytes counts.

Flow cytometry analysis: The CD3, CD4 and CD8 were measured using Cytomics FC 500 and CXP software (Beckman Coulter).

Statistical Analysis

The parameters mean values of both groups will be compared by student paired "t" test. While, the unpaired" test will be used to compare between the two groups. Pearson or Spearman rank correlation will be used to detect the relationship between polysomnographic parameters and immune system parameters include (D3 count, CD4 count and CD8 count) (P<0.05).

RESULTS

Demographic and baseline characteristics of all participants of group (A) of the asthma patients and group (B) of normal subjects revealed no significant differences between both group, while significant differences were recorded only in FVC, FEV_1 and FEV_1/FVC FEF_{25-75} (**Table 1**).

Mean values of CD3, CD4, IgG, IgA, IgM, awake time after sleep onset and REM sleep latency were significantly higher in group (A) of the asthma patients than group (B) of normal subjects. In addition to a significant lower total sleep duration and sleep efficiency in asthma group (A) compared to control group (B) (**Table 2**). Moreover, CD3, CD4, IgG, IgA, IgM showed a strong inverse relationship with total sleep duration and sleep efficiency and direct relationship with awake time after sleep onset and REM sleep latency in the asthma group (A) (**Table 3**) (P<0.05).

DISCUSSION

Asthma is a conducting airway dysfunction which characterized by reversible airway inflammation & obstruction, in addition asthma poor control was usually associated disturbed sleep [22,23]. While, appropriate sleep is essential for

proper immune system function [24-26]. Our results proved that disturbed sleep associated with altered immune system response among asthma patients, these findings agreed with many trails confirmed that impaired sleep quality was associated high risk of airways infections [27,28].

In consistent with our study, Fondel et al. and Savarde et al. reported that subjects with shorter sleep hours had 30% lower NK cells and about 50% greater activity of T-lymphocytes than normal sleepers [26,29]. However, Sakami et al. confirmed altered immunological parameters because of insomnia [30]. Moreover, Prather et al. reported that less than six hours of night sleep resulted in reduced B virus vaccine protection [31]. Similarly, Langet et al. stated that subjects sleep better after Hepatitis A virus immunization that was correlated with level of IgG antibodies [32]. Moreover, our results agreed with Wilder-Smith and coworkers confirmed significant changes in immunological parameters included CD4, CD8, CD14, and CD16 among partially sleep deprived healthy subjects [33]. Similarly, Hui and colleagues reported that sleep deprived healthy subjects experienced increased levels of immune system parameters included IgG, IgA, IgM, C3 and C4 [34]. However, Ruiz et al. stated altered pattern of sleep and partial loss of sleep adversely affect immune response that induce skin graft rejection [35]. In addition, Gumustekin et al. reported higher levels of IgG and as a result, changes in wound healing of sleep deprived rats [36]. Finally, disturbed sleep pattern affect number and activity of T helper cell, natural killer (NK) cells and myeloid dendritic cell precursors in addition to facilitation of other immune system adaptation [37-39].

The current study has important strengths and limitations. The major strength is the need to have therapeutic modalities to improve immune system performance within the epidemic COVID-19; in addition, the control group received equal attention from the research team similar to that applied to the bronchial asthma group. Moreover, the study was randomized; hence, we can extrapolate adherence to the general population. In the other hand, the major limitations is only middle age subjects enrolled in the study, so the value of this study only related to this age group, also small sample size in both groups may limit the possibility of generalization of the findings in the present study. Moreover, the nature of the intervention did not allow our study to remain blinded. Finally, within the limit of this study, therapeutic modalities as medications and aerobic exercise training are recommended for improving immune system and sleep parameters among patients with bronchial asthma. Further research is needed to explore the quality of life and other biochemical parameters among patients with bronchial asthma.

CONCLUSION

Immune system response associated with sleep parameters among patients with bronchial asthma.

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