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Association between physical activity and sleep quality in Algerian adults during COVID-19 lockdown

Adda Oudjedi[ABCDE], Mohamed Derouiche[ABCDE], Abdelghani Allali[ABCDE], Ridha Malek[ABDE], Zoubir Latreche[ABDE]

Institute of Science and Techniques of Physical and Sport Activities, Larbi Ben M'hidi University, Algeria

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Abstract

Background and Study Aim: There is no doubt that the Coronavirus disease (COVID-19) pandemic, and its related containment measures such as lockdown and social distancing, is affecting physical activity and sleep quality of the general population worldwide. Algeria, one of the most affected countries in Africa, entered the lockdown on March 9, 2020. Numerous studies have explored the interaction between physical activity and sleep quality showing the effect of physical activity levels on sleep, yet previous researches have not investigated the relationship between physical activity and sleep quality during lockdown.

Material and Methods: The main purpose of the present study was to investigate the association between physical activity and sleep quality in quarantined individuals. A national Google online survey was conducted between 16th April and 25th May 2020. 1002 Participants responded to the Pittsburgh Sleep Quality Index (PSQI) questionnaire and the short form of the International Physical Activity Questionnaire (IPAQ). Of the 1002 participants who completed the survey, 358 were students. The final data were collected from the respondents.

Results: The COVID-19 home confinement led to a decrease in physical activity levels. However, the majority of the study population had good sleep quality (61.9%), while only (38.1%) had poor sleep quality. In addition, women are less physically active than men ($p < 0.01$). Moreover, there was a significant difference in sleep quality between sufficient and insufficient physical activity groups ($p < 0.05$).

Conclusions: Our results show that Algerian adults have low levels of physical activity, good sleep quality, and poor sleep quality is associated with insufficient physical activity in adults during lockdown.

Keywords: adults, sleep quality, Algerian, survey, students.

Introduction

In December 2019, a series of pneumonia cases of unknown cause was recognized in Wuhan, China, with clinical presentations greatly resembling viral pneumonia [1]. The emergence and spread of the novel coronavirus and the related COVID-19 disease is deemed as a major public health threat for almost all countries around the world [2].

Algeria, like other countries through the world, has not escaped this pandemic respiratory disease. The actual situation shows a number of 99 610 positive cases and 2 756 deaths [3]. With the rapid spread of the COVID-19 outbreak globally, the World Health Organization (WHO) has recommended the implementation of public health measures, such as isolation of all individuals suspected of infection with this disease for a 14-day quarantine period, while respective governments have also introduced "social distancing" and "lock-downs" of entire populations of varying severity to mitigate the spread of the pandemic [4]. While these restrictions helped in decreasing the rate of infection, there may also be concomitant negative effects as a result of limiting restricting people's daily activities such as walking and cycling for transport and leisure and access to many types of recreational activities such as team sports, gyms, fitness centers, and dancing classes [5]. In this context, achieving recommended levels of physical activity (PA) is crucial to achieving the physiologic and psychosocial benefits associated with physical activity, and reduce the risk of several chronic diseases. Moreover, physical activity can attenuate the detrimental effects of sedentary behavior and its association with all-cause mortality [6]. Several studies have shown the detrimental effect of COVID-19 on physical activity and sleep quality. An Australian survey of around 1491 participants found that (48.9%) and (40.7%) reported a decrease in PA levels and sleep respectively since the onset of the COVID-19 pandemic [7].

Getting sufficient sleep has also been recommended as insufficient sleep or prolonged sleep deficiency (e.g., short sleep duration, sleep disturbance) can lead to chronic, systemic low-grade inflammation and is associated with various diseases that have an inflammatory component, like obesity, diabetes, cardiovascular diseases, neurodegeneration, and accidents. Sleeping has systematically been found to be related to lower risks

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of morbidity and mortality [8, 9]. More specifically, it is widely accepted that sleep deprivation has detrimental effects on the immune response and may impair the immune system [10]. Within this context, The American Academy of Sleep Medicine (AASM) recommends regular physical activity for proper sleep hygiene. AASM suggests exercise can be a non-pharmacological intervention for sleep quality improvement [11].

We hypothesize that COVID-19 home confinement would negatively affect sleep quality, PA levels of quarantined individuals, and that 'good sleep quality' would be associated with 'sufficient' PA. Therefore, the aims of the present study were to, (I) evaluate the effects of COVID-19 home confinement on sleep patterns and PA levels, and (II) explore the association between PA levels and sleep quality.

Materials and Methods

Participants

The sample consisted of 1002 adults (665 men and 337 women), 18 to 65 years of age from all regions of Algeria were recruited for this study. Of the 1002 participants who completed the survey, 358 were students.

Google platform was used for an anonymous survey. A link to the survey was distributed using social media (Facebook, Twitter...etc), through websites and emails. The study protocol was approved by the Institutional Review Board of the Faculty of the Institute of sport and exercise science at Oum El Bouaghi University and was conducted following the Declaration of Helsinki.

The inclusion criteria were (1) the minimum age of 18 years, (2) the current residence in Algeria, and (3) the ability to complete the questionnaires in Arabic. Other inclusion or exclusion criteria did not apply.

Research Design

The International Physical Activity Questionnaires Short Form (IPAQ-SF) was used to evaluate the PA level in participants, whose validity and reliability have been tested in 12 countries [12].

It provided information about the time and number of days spent in light, moderate, and vigorous-intensity physical activity. According to the WHO, sufficient physical activity is defined as at least (1) 150 min/week of moderate physical activity or (2) 75 min/week of vigorous physical activity or (3) an equivalent combination of both. Thus, we categorized the participants who met the aforementioned recommendation as sufficiently active compared with the participants who did not meet the recommended levels of physical activity weekly [13].

Based on the IPAQ recommendations for scoring protocol, participants of the study were classified in three different groups based on the MET–min/wk of the sum of walking, moderate-intensity physical activities, and vigorous-intensity physical activities: lowly active (< 600 MET–min/wk); moderately active (600 MET–min/wk ⩽ PA < 3000 MET–min/wk) and highly active (⩾ 3000 MET–min/wk) [14].

The sleep quality was assessed by the Pittsburgh Sleeping Quality Index Questionnaire (PSQI). It is 19 self-reported questions that examine one of the seven components of sleep quality components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, sleep medication intake, and daytime dysfunction. Each component score was rated on a 3-point scale with higher scores denote poor sleep, leading to a sum of up to 21 points. PSQI scores > 5 and ⩽ 5 indicated poor and good sleep quality, respectively [15] . It has been reported that The Arabic PSQI has an acceptable internal consistency reliability of the global PSQI (0.70) among 35 healthy Arabic participants [16].

A cross-sectional study was conducted in a convenience sample of the general population in Algeria by using online surveys. 1002 participants (665 men and 337 women, aged 18–65 years) provided full data.

Participants self-reported their height in meters (m) and weight in kilograms (kg), from which body mass index (kg/m2) was calculated. Data about demographics, physical activity, and sleep patterns were collected.

Participants completed the online survey, after reading the written consent form and explicitly agreeing to participate in the survey. The online survey was conducted between 16th April 2020 to 25th May 2020, with a total of 1002 respondents.

Statistical Analysis

Statistical analyses were performed using the commercial software "Statistical Package for the Social Sciences" (SPSS for Windows, version 20.0, SPSS Inc., Chicago, Illinois, USA) and the level of significance was set at $p < 0.05$. Using the Kolmogorov-Smirnov test, the normality of the data distribution was not confirmed.

Basic descriptive statistics of the study participants are presented as frequencies (n) and percentages (%). The Chi-Square test was used to compare physical activity levels and sleep quality between men and women. Furthermore, to analyze Sleep characteristics according to the level of physical activity, participants were split into sufficiently active and insufficiently active groups and comparative analysis was conducted by using Chi-Square ($\chi 2$). Lastly, the associations between physical activity and sleep quality domains were assessed by Pearson correlation analysis.

Results

Our study sample consisted of 1002 participants: 337 (33.6%) females and 665 (66.4 %) males. There were no missing data. Gender, age, and employment status are presented in Table 1. In general, most participants are employed for wages and students.

Table 1. Demographic characteristics of the participants.

Variables	N	%
Gender Males Females	665 337	66.36 % 33.63 %
Age		
18-30	525	52.39 %
30-40	335	33.43 %
40-50	116	11.57 %
50-60	26	2.59 %
Employment status		
Student	**358**	**35.72 %**
Employed for wages	459	45.80 %
Trainee	14	1.39 %
Self-employed	61	6.08 %
Out of work/Unemployed	100	9.98 %
Retired	10	0.99 %

In Table 2, we show the patterns of sleep quality, physical activity, and body mass index according to the participants' gender. The BMI was calculated from the reported weight and height of each participant, and it was found that (3.8%) of participants were considered underweight, while (54%) had normal BMI and (42.1%) were Overwight/ obese.

The majority of participants had light PA (63.07%) and female participants had a significantly lower prevalence of light, moderate and vigorous PA levels than males ($p < 0.01$). Moreover, two-thirds of study participants (61.9%) were good sleepers, compared with (38.1%) of the sample who reported having poor sleep quality. In addition, there were significant differences in Subjective sleep quality ($p < 0.01$), Sleep latency (p=0 , 029), Sleep efficiency (p= 0, 029) , Sleep disturbances ($p < 0, 01$) , Daytime dysfunction ($p < 0, 01$) and Sleep quality ($p < 0.01$). However, there were no differences or associations with gender were observed for sleep duration and Use of sleep medication.

The prevalence of sleeping characteristics according to the level of physical activity among the study participants is presented in Table 3. Sleep quality differed significantly according to participants' physical activity level (p =0, 039). Among the respondents, 64.4% of the physically active group reported having good sleep quality, while only 35.6% reported having poor sleep quality. However, 57.9 % enjoying good sleep quality, while 42.1% have poor sleep quality. In addition, there were significant differences in BMI status (Normal, Overweight /Obesity) ($p < 0.05$).

Table 4 shows the relationships (person's correlation) between all variables included in the analyses. Particularly, total score of PSQI was not significantly associated with the global score of PA ($P > 0.05$).

Discussion

The present study examined the association between physical activity and sleep quality among Algerian adults during the COVID-19 pandemic.

The major insight of our study about sleep quality was that the majority of the study population had good sleep quality (61.9%), while only (38.1%) had poor sleep quality. Our results seem to reflect that the changes under mobility restrictions and lockdown might have benefited sleep quality in our population. These findings are somewhat surprising given the fact that other research shows that sleep quality was markedly impaired [6, 17, 18]. However, our results are consistent with those of [19] who found no significant differences in sleep parameters.

Overall, the majority of participants reported having light or low physical activity levels during mobility restriction and home confinement. Our findings confirmed that the lockdown had a negative impact on PA levels, as it was initially expected. Being confined at home imposed a structural barrier to maintaining a physically active lifestyle [20].

Our results showed that women are less physically active than men. An analysis published in The Lancet Global Health, in 2018, found that across most countries, women are less active than men (global average of 31·7% for inactive women vs 23·4% for inactive men) [21]. In addition, a positive relationship between individuals sufficiently active and sleep quality was found. Our findings are consistent with previous studies [8, 22, 23]. It has been shown that physically active individuals had good sleep quality compared with those individuals with insufficient physical activity levels [13].

A meta-analysis of randomized trials conducted on the effect of an exercise program on sleep quality suggested that physical activity could become an alternative non-pharmacological therapy for those who are complaining of sleep problems due to its moderately positive effect on total sleep duration, slow-wave sleep, and sleep onset latency [24]. In addition, physical exercise, the especially moderate exercise showed a more promising outcomes on sleep quality than vigorous exercise [22].

The low prevalence of adequate PA levels is a main contributing factor to the high prevalence of overweight and obesity [25]. Overweight and obese individuals are more likely to have respiratory symptoms than individuals with a normal BMI, even in the absence of demonstrable lung disease [26].

In a recent meta-analysis, Banno and his colleagues showed that the exercised group

Table 2. Characteristics of the study participants, stratified by gender

Study variables	Total sample(1002)	Men Numbers (percentage%)	Women Numbers (percentage%)	χ2 P- value
1/ Subjective sleep quality				
Very good	140	104 (15.6 %)	36 (10.7 %)	
Fairly good	410	294 (44.2 %)	116 (34.4 %)	25.009
Fairly bad	223	201 (30.2 %)	122 (36.2 %)	0.000 **
Very bad	129	66 (9.9 %)	63 (18.7 %)	
2/Sleep latency (min)				
⩽15	235	167 (25.1 %)	68 (20.2 %)	
16–30	363	249 (37.4 %)	114 (33.8 %)	8.992
31–60	266	170 (25.6 %)	96 (28.5 %)	0.029 *
>60	138	79 (11.9 %)	59 (17.5 %)	
3/Sleep duration(hours)				
>7	371	239 (35.9 %)	132 (39.2 %)	
6–7	399	268 (40.3 %)	131 (38.1 %)	2.670
5–6	130	84 (12.6 %)	46 (13.6 %)	0.445
<5	102	74 (11.1 %)	28 (8.3 %)	
4/sleep efficiency (%)				
>85%	497	352 (52.9 %)	145 (43.0 %)	
75–84%	188	118 (17.7 %)	70 (20.8%)	9.020
65–74%	129	81 (12.2 %)	48 (14.2 %)	0.029*
<65%	188	114 (17.1 %)	74 (22.0 %)	
5/Sleep disturbances				
0	121	88 (13.2 %)	33 (9.8 %)	
<1/week	713	493 (74.1 %)	220 (65.3 %)	24.986
1–2/week	161	80 (12.0 %)	81 (24.0 %)	0.000**
⩾3/week	07	4 (0.6 %)	3 (0.9%)	
6/Use of sleep medication				
0	890	588 (88.4%)	302 (89.6 %)	
<1/week	58	42 (6.3 %)	16 (4.7 %)	2.121
1–2/week	27	17 (2.6 %)	12 (3.6 %)	0.548
⩾3/week	25	18 (2.7 %)	7 (2.1 %)	
7/Daytime dysfunction				
Not a problem	329	253 (38 %)	76 (22.6 %)	
Fairly a problem	471	300 (45.1 %)	171 (50.7 %)	30.117
Problem	161	86 (12.9 %)	75 (22.3 %)	0.000**
Very big problem	41	26 (3.9 %)	15 (4.5 %)	
8/Sleep quality				
Good	620	382 (57.4 %)	238 (70.6 %)	16.469
Poor	382	283 (42.6 %)	99 (29.4 %)	0.000**
9/ Physical activity				
Light	632	400 (60.2 %)	232 (68.8 %)	9.686
Moderate	180	136 (20.5 %)	44 (13.1 %)	0.008**
vigorous	190	129 (19.4 %)	61 (18.1 %)	
10/Body mass index				
underweight	38	15 (2.3 %)	23 (6.8 %)	14.487
Normal	542	356 (53.5%)	186 (55.2 %)	0.001**
Overweight /Obesity	422	294 (44.2 %)	128 (38.0 %)	

Note. *p < .05, **p < .01.

Table 3. Sleep quality index according to the level of physical activity in the study participants.

Study variables	Total sample (n=1002)	sufficient physical activity	insufficient physical activity	χ2 P- value
1/ Subjective sleep quality				
Very good	140	74 (12 %)	66 (17.1 %)	5.794
Fairly good	410	251 (40.8 %)	159 (41.1 %)	0.122
Fairly bad	323	208 (33.8 %)	115 (29.7 %)	
Very bad	129	82 (13.3 %)	47 (12.1 %)	
/2 Sleep latency (min)				
⩽15	235	139 (22.6 %)	96 (24.8 %)	
16–30	363	225 (36.6 %)	138 (35.7 %)	0.719
31–60	186	164 (26.7 %)	102 (26.4 %)	0 .869
>60	129	78 (14.1 %)	51(13.2 %)	
3/Sleep duration(hours)				
>7	371	219 (35.6 %)	152 (39.3 %)	
6–7	399	249 (40.5 %)	150 (38.8 %)	1.622
5–6	130	84 (13.7 %)	46 (11.9 %)	0.654
<5	102	63 (10.2 %)	39 (10.1 %)	
4/sleep efficiency (%)				
>85%	497	296 (48.1 %)	201 (51.9 %)	
75–84%	188	120 (19.5 %)	68 (17.6%)	2.801
65–74%	129	76 (12.4 %)	53 (13.7 %)	0.423
<65%	188	123 (20.0 %)	65(16.8 %)	
5/Sleep disturbances				
0	121	78 (12.7 %)	43 (11.1 %)	
<1/week	713	425 (69.1 %)	288 (74.4 %)	3.481
1–2/week	161	107 (17.4 %)	54 (14.0 %)	0.323
⩾3/week	07	5 (0.8 %)	2 (0.5%)	
6/Use of sleep medication				
0	890	543 (88.3%)	347 (89.7 %)	
<1/week	58	32 (5.2 %)	26 (6.7 %)	6.657
1–2/week	29	24 (3.9 %)	5 (1.3 %)	0.084
⩾3/week	24	16 (2.6 %)	9 (2.3 %)	
7/Daytime dysfunction				
Not a problem	329	197 (32 %)	132 (34.1 %)	
Fairly a problem	471	284 (46.2 %)	187 (48.3 %)	2.825
Problem	161	108 (17.6 %)	53 (13.7 %)	0.419
Very big problem	41	26 (4.2 %)	15 (3.9 %)	
8/Sleep quality				
Good	620	396 (64.4 %)	224 (57.9 %)	4.266
Poor	382	219 (35.6 %)	163 (42.1 %)	0.039*
9/ Gender				
Men	665	400 (65%)	265 (68.5 %)	1.255
Women	337	215 (35 %)	122 (31.5 %)	0.263
10/Body mass index				
Normal	542	314 (51.1%)	228 (58.9 %)	5.220
≠ Overweight /Obesity	422	275 (44.7 %)	147 (38.0 %)	0.015*

Note. *p < .05 .

Table 4. Correlation coefficients between the study variables.

Study variables	1	2	3	4	5	6	7	8	9	10	11
Subjective sleep quality	1										
Sleep latency (min)	.353**	1									
Sleep duration (hours)	-.273**	-.093**	1								
sleep efficiency (%)	-.078*	-.205**	.266**	1							
Sleep disturbances	.261**	.296**	-.075*	-.102**	1						
Use of sleep medication	.129**	.118**	-.036	.021	.193**	1					
Daytime dysfunction	.315**	.146**	-.098**	-.074*	.311**	.173**	1				
Sleep quality	.635**	.601**	-.551**	-.404**	.460**	.357**	.512**	1			
Physical activity (minutes)	-.067*	-.001	.014	.019	-.023	-.023	-.037	-.050	1		
BMI	-.017	-.021	-.117**	-.009	.049	.012	-.076*	.018	-.019	1	
Gender	.152**	.092**	.042	-.098**	.168**	-.011	.144**	.144**	-.066*	-.085**	1

Note. *p < .05, **p < .01.

decreased up to 3 points in the Pittsburgh Sleep Quality Index, and 3.22 points in the Insomnia Severity Index when compared with the control group. A slight increase in daily physical levels is an effective strategy to improve sleep duration and decrease sleep latency [27].

In adults, a high level of body mass index (BMI) is related to numerous physiological changes in lung function, regardless of asthma such as a decrease in functional residual capacity (FRC) and expiratory reserve volume (ERV). In addition, there is a moderate reduction in total lung capacity(TLC), vital lung capacity (VLC), and residual volume (RV) in obese individuals with a BMI ⩾ of 30 compared to normal-weight individuals [28]. In patients with increased abdominal obesity, pulmonary function is further compromised in supine patients by decreased diaphragmatic excursion, making ventilation more difficult. Furthermore, increased inflammatory cytokines associated with obesity may contribute to the increased morbidity associated with obesity in COVID-19 infections [29].

Another line of reasoning indicates that regular physical exercise exerts beneficial effects on sleep by acting on factors that can compromise sleep quality, such as obesity [30]. Recently, the European CBT-I Academy published practical recommendations for improving sleep problems during the COVID-19 outbreak, in which they recommend physical exercise, especially in the daylight, as a tool to sleep better [31]. However, the lack of significant association between sleep disturbances and insufficient physical activity could be explained by using self-reports to assess the level of physical activity and sleep disturbances, which might have led to different perceptions and method biases. It was highly suggested that regular moderate-intensity exercise program improves self-rated sleep quality in older adults with moderate sleep complaints [32].

As shown in Table 4, the statistical test obtained a correlation coefficient (R= -0.05) with P > 0.05, so it can be stated that there is no significant relationship between that total score of PSQI and global PA levels score during lockdown. Although, these results differ from some previously published studies [33, 34], they are consistent with those of [35, 36].

Limitations

There are some limitations that need to be considered in our study. First, the cross-sectional study design does not allow to establish causal inferences, so future well-designed longitudinal studies are needed in order to clarify causality. Second, we did not use any objective measurement for the evaluation of PA levels and sleep quality. Therefore, differentiating between the effects of physical activity and exercise on sleep quality was difficult due to the lack of information in the questionnaire to conclude if the exposure was physical activity or exercise. Moreover, validation studies of self-reported sleep show evidence of systematic bias as responses often lead to overestimation of the amount of sleep compared

to the measurement made by using actigraphy [37]. Third, the understanding of questionnaires is dependent on other individual and environmental characteristics as socioeconomic status, age, and seasonal variation [38]. In addition, daily naps, are not assessed by the PSQI questionnaire [34]. Therefore, to avoid incorrect generalisations and confirm a causal relationship between PA level and sleep quality, future studies using objective measures should be warranted.

Conclusions

In conclusion, Algerian adults are prone to low levels of physical activity and good sleep quality during lockdown. Furthermore, poor sleep quality is associated with insufficient physical activity.

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Disclosure statement

No potential conflict of interest was reported by the authors.

References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet Lond Engl*. 2020;395(10223):497– 506. https://doi.org/10.1016/S0140-6736(20)30183-5
2. Han J, Qian K, Song M, Yang Z, Ren Z, Liu S, et al. An Early Study on Intelligent Analysis of Speech Under COVID-19: Severity, Sleep Quality, Fatigue, and Anxiety. *Interspeech 2020, ISCA*; 2020. P. 4946–50. https://doi.org/10.21437/Interspeech.2020-2223
3. *Coronavirus 2019* [Internet]. 2021 [cited 2021 Jan 1]. Available from: http://www.sante.gov.dz/coronavirus/coronavirus-2019.html
4. Rubin GJ, Wessely S. The psychological effects of quarantining a city. *BMJ*, 2020:m313. https://doi.org/10.1136/bmj.m313
5. Kontsevaya AV, Mukaneeva DK, Myrzamatova AO, Okely AD, Drapkina OM. Changes in physical activity and sleep habits among adults in Russian Federation during COVID-19: a cross-sectional study. *BMC Public Health*, 2021;21:893. https://doi.org/10.1186/s12889-021-10946-y
6. Luciano F, Cenacchi V, Vegro V, Pavei G. COVID-19 lockdown: Physical activity, sedentary behaviour and sleep in Italian medicine students. *European Journal of Sport Science*, 2021;21:1459–68. https://doi.org/10.1080/17461391.2020.1842910
7. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, Anxiety and Stress during COVID-19: Associations with Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults. *Int J Environ Res Public Health*. 2020;17:4065. https://doi.org/10.3390/ijerph17114065
8. Chennaoui M, Arnal PJ, Sauvet F, Léger D. Sleep and exercise: A reciprocal issue? *Sleep Med Rev*. 2015;20:59–72. https://doi.org/10.1016/j.smrv.2014.06.008
9. Besedovsky L, Lange T, Haack M. The Sleep-Immune Crosstalk in Health and Disease. *Physiol Rev*. 2019;99(3):1325–80. https://doi.org/10.1152/physrev.00010.2018
10. Bryant PA, Trinder J, Curtis N. Sick and tired: does sleep have a vital role in the immune system? *Nat Rev Immunol*. 2004;4(6):457–67. https://doi.org/10.1038/nri1369
11. Sateia MJ, Buysse DJ, Krystal AD, Neubauer DN, Heald JL. Clinical Practice Guideline for the Pharmacologic Treatment of Chronic Insomnia in Adults: An American Academy of Sleep Medicine Clinical Practice Guideline. *Journal of Clinical Sleep Medicine*, 2017;13:307–49. https://doi.org/10.5664/jcsm.6470
12. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International Physical Activity Questionnaire: 12-Country Reliability and Validity: *Medicine & Science in Sports & Exercise*, 2003;35:1381–95. https://doi.org/10.1249/01.MSS.0000078924.61453.FB
13. Štefan L, Sporiš G, Krističević T, Knjaz D. Associations between sleep quality and its domains and insufficient physical activity in a large sample of Croatian young adults: a cross-sectional study. *BMJ Open*. 2018;8(7):e021902. https://doi.org/10.1136/bmjopen-2018-021902
14. *International Physical Activity Questionnaire* [Internet]. [cited 2021 Jan 9]. Available from: https://sites.google.com/site/theipaq/
15. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28(2):193–213. https://doi.org/10.1016/0165-1781(89)90047-4
16. Suleiman KH, Yates BC, Berger AM, Pozehl B, Meza J. Translating the Pittsburgh Sleep Quality Index Into Arabic. *West J Nurs Res*. 2009;32(2):250–68. https://doi.org/10.1177/0193945909348230
17. Cellini N, Conte F, De Rosa O, Giganti F, Malloggi S, Reyt M, et al. Changes in sleep timing and subjective sleep quality during the COVID-19 lockdown in Italy and Belgium: age, gender and working status as modulating factors. *Sleep Med*. 2021;77:112–9. https://doi.org/10.1016/j.sleep.2020.11.027
18. Pinto J, van Zeller M, Amorim P, Pimentel A, Dantas P, Eusébio E, et al. Sleep quality in times of Covid-19 pandemic. *Sleep Med*. 2020;74:81–5.

https://doi.org/10.1016/j.sleep.2020.07.012
19. da Silva Santos AM, Rossi FE, dos Santos Nunes de Moura HP, de Sousa Junior AVM, Machado DCD, Neves LM, et al. COVID-19 pandemic impacts physical activity levels and sedentary time but not sleep quality in young badminton athletes. *Sport Sci Health*, 2021;17:969–77. https://doi.org/10.1007/s11332-021-00763-6
20. Martínez-de-Quel Ó, Suárez-Iglesias D, López-Flores M, Pérez CA. Physical activity, dietary habits and sleep quality before and during COVID-19 lockdown: A longitudinal study. *Appetite*, 2021;158:105019. https://doi.org/10.1016/j.appet.2020.105019
21. The Lancet Public Health. Time to tackle the physical activity gender gap. *Lancet Public Health,* 2019;4(8): e360. https://doi.org/10.1016/S2468-2667(19)30135-5
22. Wang F, Boros S. The effect of physical activity on sleep quality: a systematic review. *Eur J Physiother*. 2021;23(1):11–8. https://doi.org/10.1080/21679169.2019.1623314
23. Dolezal BA, Neufeld EV, Boland DM, Martin JL, Cooper CB. Interrelationship between Sleep and Exercise: A Systematic Review. *Advances in Preventive Medicine*, 2017;2017:1–14. https://doi.org/10.1155/2017/1364387
24. Mahfouz MS, Ali SA, Bahari AY, Ajeebi RE, Sabei HJ, Somaily SY, et al. Association Between Sleep Quality and Physical Activity in Saudi Arabian University Students. *Nat Sci Sleep*. 2020;12:775–82. https://doi.org/10.2147/NSS.S267996
25. Kontsevaya A, Shalnova S, Deev A, Breda J, Jewell J, Rakovac I, et al. Overweight and Obesity in the Russian Population: Prevalence in Adults and Association with Socioeconomic Parameters and Cardiovascular Risk Factors. *Obes Facts*. 2019;12(1):103–14. https://doi.org/10.1159/000493885
26. Zammit C, Liddicoat H, Moonsie I, Makker H. Obesity and respiratory diseases. *Int J Gen Med*. 2010;3:335–43. https://doi.org/10.2147/IJGM.S11926
27. Diniz TA, Christofaro DGD, Tebar WR, Cucato GG, Botero JP, Correia MA, et al. Reduction of Physical Activity Levels During the COVID-19 Pandemic Might Negatively Disturb Sleep Pattern. *Front Psychol.* 2020;11: 3356. https://doi.org/10.3389/fpsyg.2020.586157
28. Farzan S. The Asthma Phenotype in the Obese: Distinct or Otherwise? *Journal of Allergy*, 2013;2013:1–8. https://doi.org/10.1155/2013/602908
29. Dietz W, Santos-Burgoa C. Obesity and its Implications for COVID-19 Mortality. *Obesity*. 2020;28(6):1005–1005. https://doi.org/10.1002/oby.22818
30. *SciELO - Brazil - Sleep quality and its associations with leisure-time exercise and excess weight among civil servants Sleep quality and its associations with leisure-time exercise and excess weight among civil servants* [Internet]. 2021 [cited 2021 Aug 2]. Available from: https://www.scielo.br/j/rbcdh/a/V66qZZzVBJWVhkGVgJP3thq/?lang=en
31. Altena E, Baglioni C, Espie CA, Ellis J, Gavriloff D, Holzinger B, et al. Dealing with sleep problems during home confinement due to the COVID-19 outbreak: Practical recommendations from a task force of the European CBT-I Academy. *J Sleep Res*. 2020;29(4): e13052. https://doi.org/10.1111/jsr.13052
32. King AC, Oman RF, Brassington GS, Bliwise DL, Haskell WL. Moderate-Intensity Exercise and Self-rated Quality of Sleep in Older Adults: A Randomized Controlled Trial. *JAMA*. 1997;277(1):32–7. https://doi.org/10.1001/jama.277.1.32
33. Ammar A, Trabelsi K, Brach M, Chtourou H, Boukhris O, Masmoudi L, et al. Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: Insight from the ECLB-COVID19 multicenter study. *Biology of Sport*, 2021;38:9–21. https://doi.org/10.5114/biolsport.2020.96857
34. Trabelsi K, Ammar A, Masmoudi L, Boukhris O, Chtourou H, Bouaziz B, et al. Globally altered sleep patterns and physical activity levels by confinement in 5056 individuals: ECLB COVID-19 international online survey. *Biol Sport.* 2021;38(4):495–506. https://doi.org/10.5114/biolsport.2021.101605
35. Cavalcante MV, Siqueira RCL, Costa RC, Lima TF, Costa TM, Costa CLA. Associations between physical activity and sleep quality in the pandemic context of social distancing. *Res Soc Dev.* 2021;10(1):e8610111471. https://doi.org/10.33448/rsd-v10i1.11471
36. Mitchell JA, Godbole S, Moran K, Murray K, James P, Laden F, et al. No Evidence of Reciprocal Associations between Daily Sleep and Physical Activity. *Med Sci Sports Exerc*. 2016;48(10):1950–6. https://doi.org/10.1249/MSS.0000000000001000
37. Kim M. Association between Objectively Measured Sleep Quality and Obesity in Community-dwelling Adults Aged 80 Years or Older: A Cross-sectional Study. *J Korean Med Sci,* 2015;30:199. https://doi.org/10.3346/jkms.2015.30.2.199
38. Wendt A, Flores TR, Silva ICM, Wehrmeister FC. Association of physical activity with sleep health: A systematic review. *Rev Bras Ativ Fís Saúde,* 2019;23:1–26. https://doi.org/10.12820/rbafs.23e0057

Information about the authors:

Adda Oudjedi; (Corresponding author); Lecturer in sport and exercise science ; https://orcid.org/0000-0002-6632-2315; adda.oudjedi@univ-oeb.dz; Institute of Science and Techniques of Physical and Sport Activities; Larbi Ben M'hidi University, B.P. 358 Route de Constantine, 04000 Oum El Bouaghi, Algeria.

Mohamed Derouiche; lecturer in sport and exercise science ; https://orcid.org/0000-0001-6723-0386; istsmohamed@hotmail.fr; Institute of Science and Techniques of Physical and Sport Activities; Larbi Ben M'hidi University, Oum El Bouaghi, Algeria.

Abdelghani Allali; lecturer in sport and exercise science; https://orcid.org/0000-0002-3931-2250; allali.ghani@univ-oeb.dz; Institute of Science and Techniques of Physical and Sport Activities; Larbi Ben M'hidi University, Oum El Bouaghi, Algeria.

Redha Malek; lecturer in sport and exercise science; https://orcid.org/0000-0003-2953-8253; ridha.malek@univ-oeb.dz; Institute of Science and Techniques of Physical and Sport Activities; Larbi Ben M'hidi University, Oum El Bouaghi, Algeria.

Zoubir Latreche; lecturer in sport and exercise science; https://orcid.org/0000-0003-1759-4397; zoubir_l@yahoo.fr; Institute of Science and Techniques of Physical and Sport Activities; Larbi Ben M'hidi University, Oum El Bouaghi, Algeria.

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