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Morning headaches and sleep disturbance in the general Algerian population

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Abstract:
Background: *To date, there is a lack of prospective data on the subjective quality of sleep in subjects complaining of morning headaches (MH). Thus, the aim of this study was to determine the prevalence of MH in the general Algerian population and their relationship to sleep disorders.*
Materials and Methods*: We carried out between the period from 01/11/2017 to 30/11/2017 an epidemiological study on sleep in the department of El Biar (Algiers, Algeria) with a sample of 2500 people aged 18 and over. We used screening questionnaires to identify participants most likely to have experienced MH in the three months prior to the study.*
Results: *Of the 2,500 subjects surveyed, 706 reported MH or a prevalence of 28.24% [26.8; 29.72]. They were on average older than the respondents not reporting MH were (49 years vs. 46 years; p <0.001). The prevalence of MH was higher among women (30.4% vs. 25.5%; p = 0.008) and night or irregular workers (47.4% vs. 26.3%; p=0.002). It was lower among singles (24.2% vs. 30.5%; p=0.001) and morning people (23.9% vs. 38.2%; p<0.001). However, after adjustment only female respondents and morning peoplewere significantly associated with the risk of MH (ORa 1.43; 95% CI [1.15; 1.79]; p<0.001 and 0.71 [0.56, 0.9]; p=0.005), and to a lesser extent unmarried respondents (0.76 [0.57; 1.01]; p=0.06). The other independent risk factors were diabetes (1.54; [1.09 , 2.17]; p =0.01), hypothyroidism (2.11; [1.21 , 3.7]; p =0.009), difficulty falling asleep (1.85;[1.2 , 2.84]; p =0.005), sleep apnea (1.54; [1.14 , 2.08]; p =0.005), sleep time (1.09; [1.01 , 1.18]; p =0.03), Oversleeping (1.51; [1.16 , 1.95]; p=0.002), as well as the presence of parasomnia such as somnambulism (1.65;[1.02;2.67];p =0.04), nightmares (1.77; [1.41;2.22];p <0.001) confusional arousals (1.53;[1.08;2.18]; p =0.02); and somniloquy (1.42;[1.11;1.81]; p =0.005). There was no statistically significant relationship between MH and BMI. However, respondents with MH reported frequent use of tobacco (cigarettes), tea, coffee and alcohol, as well as more frequent napping. They reported poorer sleep and waking up quality, with daytime sleepiness.*
Conclusion: *MH are common in the Algerian population, with about 1 in 4 respondents reporting them. They are likely multifactorial and involve sleep disorders. The identification of the various factors associated in the occurrence of MH will allow a medical care responsive to individual patient needs.*
Keywords*: morning headaches, epidemiology, sleep disorders, insomnia; daytime sleepiness, sleep apnea, sleepwalking, nightmares, REM sleep disorder, restless leg syndrome, sleepiness, bruxism, smoking.*

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I. Introduction

Headaches and sleep disorders are the most frequent complaints reported in clinical practice. There is a clear association between chronic headaches and sleep disorders. Morning headaches too are far from being rare, affecting between 5 and 7.6% of the general population [1] [2]. They could be related to multiple factors including high blood pressure, migraines, anxiety, depressive disorders, or the consumption of sleeping pills and they could particularly be indicative of a sleep disorder such as insomnia, a sleep-related breathing disorder etc., and are often associated with a bad night's sleep. Several studies have shown a significant association between MH and sleep disorders, without linking them exclusively. With this in mind, we conducted a study on the prevalence of MH and their relationship to sleep disorders in a sample based on the general population.

II. Material And Methods

This is a cross-sectional door-to-door study carried out between 01/11/2017 and 30/11/2017,in thedepartmentof El Biar in the city of Algiers. It is an urban department of 48,898 inhabitants; it has 9,568 households according to the cartographic division in the 2008 Algerian Population and Housing Census. We chose the department of El Biar for its proximity to the hospital and the availability of the investigator to answer any questions (contact point on the questionnaire).

The study involved 2,500 subjects aged 18 and over who were selected in a random probability sample survey. 28 districts were drawn from all the districts in the department and an average of 25 households per district were drawn as samples. For each household, all subjects aged 18 and over were selected for an interview with the exclusion of subjects suffering from a verbal or hearing disability and those whose health status does not allow them to participate in the survey (psychiatric pathology, dementia, epilepsy...). Trained investigators from the National Office of Statistics collected the data, in a face-to-face interview.

A questionnaireconsisting of two sectionswas prepared for this purpose. The first section concerned the demographic information (age, sex, and marital status), body mass index (BMI), occupational activity and personal medical history. The second part contained various sleep-related items concerning the three months preceding the survey.

We assessed the prevalence of MH using the following question: Do you ever have a headache in the morning when you wake up?

We assessed the usual bedtime in relation to midnight (00:00 am) as reference time and the usual wake up time in relation to noon (12:00 pm) as reference time.

We considered sleep duration excessive if it was at least 1 hour longer and insufficient if it was at least 1 hour shorter than the estimated time needed by the respondent.

We assessed the perceived quality of sleep using the question “Are you satisfied with your sleep?” respondents reporting satisfied or dissatisfied.

We assessed the form upon waking by the question « When you wake up, you often feel in excellent, good, medium or bad shape».

We assessed daytime sleepiness (DS) using the Epworth Sleepiness Scale.

We assessed insomnia by the presence of difficulty falling asleep with increased sleep latency (more than 30 minutes), and/or difficulty maintaining sleep with many awakenings (more than 3 per night), an early awakening, and the feeling of not sleeping.

We appreciated Obstructive Sleep Apnea Syndrome (OSA) through the presence of snoring, and breathing pauses.

We used the RBD Single-Question Screen (RBD1Q) to identify REM sleep behavior disorder (RBD). We asked the respondent to answer the question “Do you experience restless sleep and kicking, punching, arm flailing, etc… during your sleep?".

We evaluated the RLS using the following question: "Do you feel uncomfortable and painful restlessness in your legs at night with a desire to move your legs?" If the answer was yes, we asked the respondent to clarify their discomfort using the Restless Leg Gravity Scale.

We also asked respondents to answer the following questions: Do you grind your teeth at night, or do you have jaw pain; do you sleepwalk; do you have nightmares; do you sometimes wake up confused, do you feel completely paralyzed; do you ever talk while sleeping?

The data was entered on Epi info 7. The control of the data was made on MS Excel. The analysis was performed on the R4.2.0 software. Qualitative variables were represented by their numbers and percentages. The prevalence of the different sleep disorder indicators was estimated with a 95% confidence interval. The quantitative variables were represented by their means and standard deviation.

The Khi 2 test was performed to compare two or more qualitative variables. The Student’s t-test was performed for the comparison of two quantitative variables and the analysis of variances (ANOVA) for the comparison of more than two quantitative variables. The risk factor analysis was performed using stepwise logistic regression. The variables included in the regression model are those that were significant across the comparison. Ambivalent variables were not included although they were significant. The significance threshold of the statistical tests was $p < 0.05$.

III. Results

The general characteristics of the sample are shown in Table 1 and Table 2. 1384 (55.36%) were female. The average age was 46.87 (18.96) years old (women = 46.6 years vs. men = 47.2 years; p=0.41). Individuals aged 65 and over accounted for 20.56% of the sample. More than half (55.52%) were unemployed or retired (68.2% of women and 39.8% of men; p<0.001). The majority of active individuals worked during the day. Only 1.44% had irregular working hours and 0.88% had night work. High blood pressure and diabetes were the most reported comorbidities, respectively 14.24% and 11.28%.

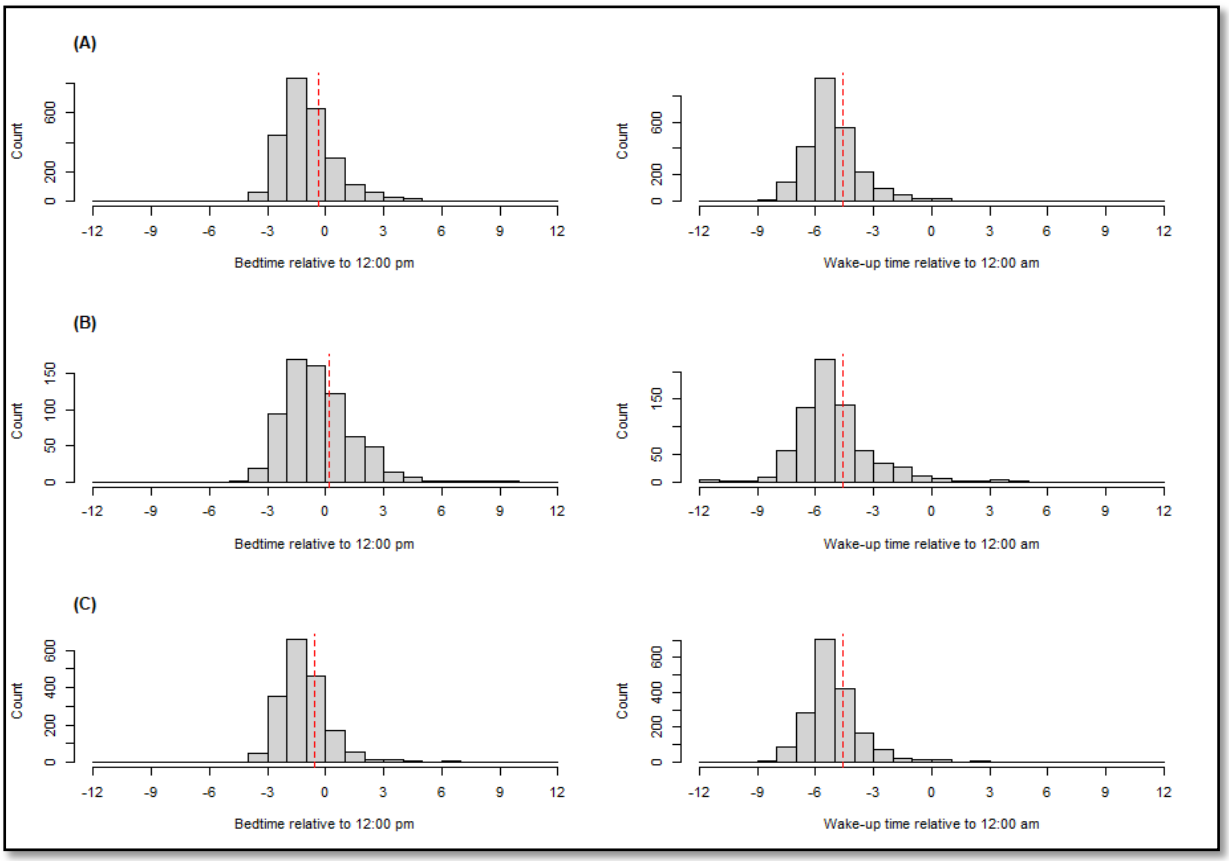
Table 1: Characteristic of the sample

		Morningheadaches			
	Total	Yes	No	Prevalence [IC95%]	p
Age					<0.001
- *Mean (sd)*	46.87 (18.96)	49.01 (19.4)	46.03 (18.73)	—	
Femalegender					0.008
- *No, n (%)*	1116 (44.64)	285 (40.37)	831 (46.32)	25.54 [23.48 ; 27.68]	
- *Yes, n (%)*	1384 (55.36)	421 (59.63)	963 (53.68)	30.42 [28.45 ; 32.45]	
Marital status					<0.001
- *Married, n (%)*	1378 (55.12)	395 (55.95)	983 (54.79)	28.66 [26.73 ; 30.66]	
-*Single., n (%)*	888 (35.52)	215 (30.45)	673 (37.51)	24.21 [21.97 ; 26.58]	
- *Divorced, n (%)*	59 (2.36)	27 (3.82)	32 (1.78)	45.76 [36.21 ; 55.58]	
- *Widowed, n (%)*	175 (7)	69 (9.77)	106 (5.91)	39.43 [33.79 ; 45.31]	
Workschedule					0.002
- *Inactive, n (%)*	1388 (55.52)	408 (57.79)	980 (54.63)	29.39 [27.45 ; 31.4]	
- *Day, n (%)*	1055 (42.2)	271 (38.39)	784 (43.7)		
- *Night, n (%)*	22 (0.88)	9 (1.275)	13 (0.72)	40.91 [27.13 ; 56.09]	
- *Irregular, n (%)*	35 (1.4)	18 (2.55)	17 (0.95)	51.43 [39.17 ; 63.54]	
Chronotye					<0.001
- *Morning, n (%)*	1739 (69.56)	415 (58.78)	1324 (73.8)	23.86 [22.24 ; 25.55]	
- *Evening, n (%)*	217 (8.68)	97 (13.74)	120 (6.689)	44.7 [39.45 ; 50.05]	
- *Indiff., n (%)*	544 (21.76)	194 (27.48)	350 (19.51)	35.66 [32.44 ; 39]	
Bedtime on weekdays compared to reference time 00:00 am					<0.001
- *Mean (sd)*	-0.39 (1.53)	0.15 (1.82)	-0.60 (1.35)	—	
Wake up time on weekdays compared to reference time 12:00 pm					0.95
- *Mean (sd)*	-4.56 (1.62)	-4.57 (1.92)	-4.58 (1.48)	—	
Sleep duration					<0.001
- *Sufficient, n (%)*	918 (36.72)	155 (21.95)	763 (42.53)	16.88 [14.98 ; 18.94]	
-*Insufficient, n (%)*	397 (15.88)	88 (12.46)	309 (17.22)	22.17 [19.01 ; 25.61]	
- *Excessive, n (%)*	1185 (47.4)	463 (65.58)	722 (40.25)	39.07 [36.8 ; 41.38]	

Table 2 : Comorbidity

		MorningHeadaches			
	Total	Yes	No	Prevalence [IC95%]	p
BMI					0.552
- *Mean (sd)*	25.24 (3.745)	25.31 (4.22)	25.21 (3.54)	—	
Diabetes					<0.001
- *No, n (%)*	2218 (88.72)	592 (83.85)	1626 (90.64)	26.69 [25.19 ; 28.23]	
- *Yes, n (%)*	282 (11.28)	114 (16.15)	168 (9.365)	40.43 [35.88 ; 45.11]	
Hypercholesterolemia					0.07
- *No, n (%)*	2460 (98.4)	689 (97.59)	1771 (98.72)	28.01 [26.56 ; 29.5]	
- *Yes, n (%)*	40 (1.6)	17 (2.408)	23 (1.282)	42.5 [31.46 ; 54.22]	
High blood pressure					<0.001
- *No, n (%)*	2144 (85.76)	566 (80.17)	1578 (87.96)	26.4 [24.88 ; 27.96]	
- *Yes, n (%)*	356 (14.24)	140 (19.83)	216 (12.04)	39.33 [35.28 ; 43.5]	
Myocardialinfarction					0.35
- *No, n (%)*	2477 (99.08)	697 (98.73)	1780 (99.22)	28.14 [26.69 ; 29.62]	
- *Yes, n (%)*	23 (0.92)	9 (1.275)	14 (0.7804)	39.13 [25.82 ; 54.05]	
Heartrhythmdisorder					<0.001
- *No, n (%)*	2447 (97.88)	677 (95.89)	1770 (98.66)	27.67 [26.22 ; 29.15]	
- *Yes, n (%)*	53 (2.12)	29 (4.108)	24 (1.338)	54.72 [44.4 ; 64.7]	
Heartfailure					0.94
- *No, n (%)*	2480 (99.2)	701 (99.29)	1779 (99.16)	28.27 [26.82 ; 29.75]	
- *Yes, n (%)*	20 (0.8)	5 (0.7082)	15 (0.8361)	25 [13.96 ; 40.1]	
Stroke					0.26
- *No, n (%)*	2487 (99.48)	700 (99.15)	1787 (99.61)	28.15 [26.7 ; 29.63]	
- *Yes, n (%)*	13 (0.52)	6 (0.8499)	7 (0.3902)	46.15 [28.7 ; 64.52]	
Parkinson'sdisease					0.02
- *No, n (%)*	2489 (99.56)	699 (99.01)	1790 (99.78)	28.08 [26.64 ; 29.56]	
- *Yes, n (%)*	11 (0.44)	7 (0.9915)	4 (0.223)	63.64 [43.56 ; 80.04]	
Depression					0.66
- *No, n (%)*	2493 (99.72)	703 (99.58)	1790 (99.78)	28.2 [26.76 ; 29.68]	
- *Yes, n (%)*	7 (0.28)	3 (0.4249)	4 (0.223)	42.86 [22.53 ; 65.87]	
Hypothyroidism					<0.001
- *No, n (%)*	2427 (97.08)	668 (94.62)	1759 (98.05)	27.52 [26.07 ; 29.01]	
- *Yes, n (%)*	73 (2.92)	38 (5.382)	35 (1.951)	52.05 [43.17 ; 60.83]	
Gastroesophageal reflux					0.162
- *No, n (%)*	2477 (99.08)	696 (98.58)	1781 (99.28)	28.1 [26.65 ; 29.58]	
- *Yes, n (%)*	23 (0.92)	10 (1.416)	13 (0.7246)	43.48 [29.61 ; 58.32]	

The average bedtime for the 00:00 am reference time was -0.4 (1.5) or 23:37' and the average wake up time for the 12:00 pm reference time was -4.6 (1.6) or 07:25' [Figure 1 (A)].



(A) Global
(B) With morning headaches (C) Without morning headaches
Red line: average

Figure 1. Sleep and Wake Up Times

A total of 706 respondents reported MH, a prevalence of 28.24% [26.8; 29.72].
Women reported MH more frequently than men (30.4% vs. 25.5%; p = 0.008). The average age of respondents reporting MH was higherthan those not reporting MH (49 years vs. 46 years; p <0.001). The prevalence of MH was lowest among singles (24.2%) compared to married, divorced and widowed respondents (28.6%, 45.8% and 39.4%; p<0.001).
The prevalence of MH was significantly higher among respondents reporting a comorbidity, such as diabetes, hypertension, heart rhythm disorders, hypothyroidism, and Parkinson's disease (Table 2).
Respondents reporting night or irregular hours of work had a significantly higher prevalence of MH compared to others (47.4% vs. 26.3%; p=0.002).
Morning people reported MH less frequently (23.9%) compared to others (38.2; p<0.001).
Among those reporting MH, 49.2% reported napping, compared to 29.4% among others (p<0.001). The frequency of coffee, tea, tobacco, and alcohol consumption was significantly higher among respondents with MH than those without (Table 3).

Table 3 : Lifestyle

		Morningheadaches			
	Total	Yes	No	Prevalence [IC95%]	p
Coffee consumption					<0.001
- No, n (%)	955 (38.2)	221 (31.3)	734 (40.91)	23.14 [21.01 ; 25.39]	
- Yes, n (%)	1545 (61.8)	485 (68.7)	1060 (59.09)	31.39 [29.51 ; 33.33]	
Teaconsumption					<0.001
- No, n (%)	1947 (77.88)	504 (71.39)	1443 (80.43)	25.89 [24.31 ; 27.52]	
- Yes, n (%)	553 (22.12)	202 (28.61)	351 (19.57)	36.53 [33.31 ; 39.85]	
Alcoholconsumption					<0.001
- No, n (%)	2458 (98.32)	684 (96.88)	1774 (98.89)	27.83 [26.38 ; 29.31]	
- Yes, n (%)	42 (1.68)	22 (3.116)	20 (1.115)	52.38 [41.01 ; 63.54]	

Tobacco cigarette consumption					<0.001
- No, n (%)	2172 (86.88)	587 (83.14)	1585 (88.35)	27.03 [25.5 ; 28.59]	
- Yes, n (%)	328 (13.12)	119 (16.86)	209 (11.65)	36.28 [32.16 ; 40.57]	
Napping					<0.001
- No, n (%)	1625 (65)	359 (50.85)	1266 (70.57)	22.09 [20.47 ; 23.79]	
- Yes, n (%)	875 (35)	347 (49.15)	528 (29.43)	39.66 [37.02 ; 42.34]	

The prevalence of MH was higher among respondents reporting insomnia indicators compared to others and increased with the number of the reported insomnia indicators. It is 15.8%, 53.5%, 60.5%, 76.7%, 88.9% respectively for respondents reporting no indicators, 1 indicator, 2 indicators, 3 indicators and 4 indicators ($p<0.001$). The prevalence of MH was high among respondents reporting difficulty falling asleep (64.7% vs. 17.3%; $p<0.001$) and among those reporting parasomnias (33.3% vs. 22%; $p<0.001$) (Table 4). Among individuals reporting sleep apnea, the prevalence of MH was significantly higher than in others (50.2% vs. 24.9; $p<0.001$). (Table 4)

Table 4 : Sleepdisorders

		Morningheadaches			
	Total	Yes	No	Prevalence [IC95%]	p
Number of insomniaindicators					<0.001
- 0, n (%)	1859 (74.36)	294 (41.64)	1565 (87.24)	15.81 [14.49 ; 17.22]	
- 1, n (%)	198 (7.92)	106 (15.01)	92 (5.128)	53.54 [47.95 ; 59.05]	
- 2, n (%)	261 (10.44)	158 (22.38)	103 (5.741)	60.54 [55.69 ; 65.22]	
- 3, n (%)	110 (4.4)	84 (11.9)	26 (1.449)	76.36 [69.73 ; 82.07]	
- 4, n (%)	72 (2.88)	64 (9.065)	8 (0.4459)	88.89 [82.51 ; 93.32]	
Presence of difficulty falling asleep					<0.001
- No, n (%)	1922 (76.88)	332 (47.03)	1590 (88.63)	17.27 [15.92 ; 18.7]	
- Yes, n (%)	578 (23.12)	374 (52.97)	204 (11.37)	64.71 [61.48 ; 67.83]	
Apnea					<0.001
- No, n (%)	2167 (86.68)	539 (76.35)	1628 (90.75)	24.87 [23.39 ; 26.4]	
- Yes, n (%)	333 (13.32)	167 (23.65)	166 (9.253)	50.15 [45.8 ; 54.49]	
Sleepwalking					<0.001
- No, n (%)	2394 (95.76)	652 (92.35)	1742 (97.1)	27.23 [25.78 ; 28.73]	
- Yes, n (%)	106 (4.24)	54 (7.649)	52 (2.899)	50.94 [43.47 ; 58.38]	
Somniloquy					<0.001
- Non, n (%)	1866 (74.64)	456 (64.59)	1410 (78.6)	24.44 [22.86 ; 26.07]	
- Oui, n (%)	634 (25.36)	250 (35.41)	384 (21.4)	39.43 [36.36 ; 42.58]	
Sleeprelatedbruxism					<0.001
- No, n (%)	2383 (95.32)	655 (92.78)	1728 (96.32)	27.49 [26.02 ; 28.99]	
- Yes, n (%)	117 (4.68)	51 (7.224)	66 (3.679)	43.59 [36.64 ; 50.76]	
Nightmaredisorder					<0.001
- No, n (%)	1463 (58.52)	327 (46.32)	1136 (63.32)	22.35 [20.63 ; 24.15]	
- Yes, n (%)	1037 (41.48)	379 (53.68)	658 (36.68)	36.55 [34.17 ; 38.98]	
RBD					0.002
- No, n (%)	2449 (97.96)	681 (96.46)	1768 (98.55)	27.81 [26.36 ; 29.29]	
- Yes, n (%)	51 (2.04)	25 (3.541)	26 (1.449)	49.02 [38.69 ; 59.42]	
Sleepparalysis					0.05
- No, n (%)	2000 (80)	547 (77.48)	1453 (80.99)	27.35 [25.76 ; 28.99]	
- Yes, n (%)	500 (20)	159 (22.52)	341 (19.01)	31.8 [28.55 ; 35.2]	
Confusional arousals					<0.001
- No, n (%)	2262 (90.48)	573 (81.16)	1689 (94.15)	25.33 [23.87 ; 26.84]	
- Yes, n (%)	238 (9.52)	133 (18.84)	105 (5.853)	55.88 [50.77 ; 60.9]	
RLS					<0.001
- No, n (%)	2004 (80.16)	480 (67.99)	1524 (84.95)	23.95 [22.44 ; 25.52]	
- Yes, n (%)	496 (19.84)	226 (32.01)	270 (15.05)	45.56 [42.01 ; 49.15]	

RBD: REM sleep behavior disorder;**RLS**: restless legs syndrome

The average weekly bedtime compared to the 00:00 am reference time averaged 0.15 for respondents reporting MH and -0.60 for respondents not reporting MH ($p<0.001$). There was no significant difference in the wake-up time from the 12:00 pm reference time (-4.57 vs -4.58; $p=0.95$) [Figure 1 (B) and Figure 1 (C)].

The frequency of MH varied significantly with sleep duration ($p<0.001$). Among respondents reporting insufficient sleep time, 39% reported MH. This frequency is 22.2% among those reporting excessive sleep and 16.9% among those reporting sufficient sleep).

Among respondents reporting MH, 47.3% reported a bad form waking up, 30.1% an average form, 19.7 a good form and 2.3% an excellent form in comparison with 7.5%, 35.2%, 46.3% and 11% respectively compared to others ($p<0.001$).

Sleep quality was rated satisfactory by 41% of respondents reporting MH and 86.6% of respondents not reporting MH (p<0.001).
Sleepiness was significantly more common among those reporting MH than among others (67.9% vs. 48.1%; p<0.001).
There was no statistically significant relationship between MH and the BMI. (Table 5 and Table 2).

Table 5: Daytime activity and wake-up form

		Morningheadaches			
	Total	Yes	No	Prevalence [IC95%]	p
Sleepiness					<0.001
- *No, n (%)*	1159 (46.36)	227 (32.15)	932 (51.95)	19.59 [17.77, 21.51]	
- *Yes, n (%)*	1341 (53.64)	479 (67.85)	862 (48.05)	35.72 [33.63, 37.86]	
Wakingshape					<0.001
- Bad., n (%)	468 (18.72)	334 (47.31)	134 (7.469)	71.37 [67.95 ; 74.6]	
- Mean., n (%)	849 (33.96)	217 (30.74)	632 (35.23)	25.56 [23.22 ; 28.02]	
- Good, n (%)	970 (38.8)	139 (19.69)	831 (46.32)	14.33 [12.61 ; 16.2]	
- Excellent, n (%)	213 (8.52)	16 (2.266)	197 (10.98)	7.512 [5.149 ; 10.64]	
Satisfactoryquality of sleep					<0.001
- *No, n (%)*	656 (26.24)	416 (58.92)	240 (13.38)	63.41 [60.36 ; 66.39]	
- *Yes, n (%)*	1844 (73.76)	290 (41.08)	1554 (86.62)	15.73 [14.4 ; 17.13]	

The variables smoking, alcohol, tea and coffee, napping, waking form, quality of sleep and sleepiness, although significantly associated with the risk of MH in bivariate analysis (Table 3), were not included in the multiple logistic regression model because their relationship to MH is possibly ambivalent (Table 6)

Table 6: Results of multiple logistic regression for headache risk prediction

	ORa [IC 95 %]	p
Age (years)	1 [0.99 ; 1.01]	0.61
Female gender (yes vs.no)	1.43 [1.15 ; 1.79]	0.001 **
Single (yes vs . no)	0.76 [0.57 ; 1.01]	0.06 ·
Night or irregular working hours *(yes vs. no)*	1.21 [0.62 ; 2.35]	0.58
Diabetes (yes vs. no)	1.54 [1.09 ; 2.17]	0.01
High blood pressure (yes vs. no)	0.94 [0.67 ; 1.32]	0.72
Parkinson's disease (yes vs. no)	0.73 [0.17 ; 3.21]	0.68
Hypothyroidism*(yes vs. no)*	2.11 [1.21 ; 3.7]	0.009 **
Weekdaybedtime (hours)	1.09 [1.01 ; 1.18]	0.03 *
Sleep duration		
- Insufficient vs. sufficient	1.26 [0.91 ; 1.74]	0.17
Excessive vs. sufficient	1.51 [1.16 ; 1.95]	0.002
Morning people *(yes vs. no)*	0.71 [0.56 ; 0.9]	0.005 **
Number of insomniaindicator		
- *1 sign vs. none*	2.64 [1.64 ; 4.23]	<0.001 ***
- *2 signs vs. None*	2.82 [1.74 ; 4.55]	<0.001 ***
- *3 signs vs. None*	5.17 [2.75 ; 9.72]	<0.001 ***
- *4 signs vs. none*	11.66 [4.84 ; 28.07]	<0.001 ***
Presence of difficulty falling asleep *(yes vs. no)*	1.85 [1.2 ; 2.84]	0.005 **
Sleep Apnea *(yes vs. no)*	1.54 [1.14 ; 2.08]	0.005 **
Parasomnia : Sleepwalking *(yes vs. no)*	1.65 [1.02 ; 2.67]	0.04 *
Parasomnia : Sleep talking (yes vs. no)	1.42 [1.11 ; 1.81]	0.005 **
Bruxism (yes vs. no)	1.03 [0.63 ; 1.69]	0.90
Parasomnia : Nightmare disorder (yes vs. no)	1.77 [1.41 ; 2.22]	<0.001 ***
Parasomnia : RBD (yes vs. no)	0.73 [0.35 ; 1.54]	0.41
Parasomnia : Sleep paralysis (yes vs. no)	0.99 [0.75 ; 1.3]	0.94
Parasomnia : confusionnel arousal (yes vs. no)	1.53 [1.08 ; 2.18]	0.02 *
RLS (yes vs. no)	1.26 [0.97 ; 1.65]	0.09 ·

ORa : adjusted Odds ratio ; **IC 95%** : 95 % confidence interval ; **RBD:** REM sleep Behavior disorder; **RLS**: restless leg syndrome

Statistically the significant risk factors are the female gender (ORa 1.43; 95% CI [1.15; 1.79]; p<0.001), diabetes (ORa 1.54; [1.09, 2.17]; 0.01), hypothyroidism (ORa 2.11; [1.21, 3.7]; 0.009), difficulty falling asleep (ORa 1.85; [1.2, 2.84]; 0.005) and sleep apnea (ORa 1.54; [1.14, 2.08]; 0.005).
Morning people (ORa 0.71 [0.56, 0.9]; 0.005) are associated with significantly reduced risk of MH.

Late bedtime increases the risk of MH. The risk is multiplied by 1.09 (95% CI [1.01, 1.18]; p=0.03) for each hour of delayed bedtime. Excessive sleep also increases the risk of morning headaches (1.51; [1.16, 1.95] P=0.002).

The presence of parasomnias such as sleepwalking (1.65;[1.02;2.67];p=0.04), nightmares (1.77; [1.41;2.22];p<0.001), confusional arousal (1.53;[1.08;2.18]; p=0.02);and somniloquy (1.42;[1.11;1.81];p=0.005), was associated with an increased risk of MH. However, we did not find a significant relationship with other parasomnias or abnormal sleep-related movements. (Table 6)

IV.Discussion

Our study showed that MH are far from being rare in the Algerian adult population, with a prevalence of 28.24%. It should be noted that the characteristics of the headaches were not included in the survey;the purpose of the study was to have an overall prevalence of MH in relation to sleep disorders. For this, we focused on the role of different factors in triggering MH. The prevalence of MH in our sample is significantly higher compared to the few studies that looked at MH, where the prevalence was between 5 and 7.6% [1, 2]. Among demographic factors, the prevalence of MH is significantly higher among females, married and middle-aged respondents;however, women were overrepresented in our sample.

The correlation was also positive concerning the professional activity. The potential explanation among retirees and unemployed respondents who were also overrepresented in our sample, would be the loss of work-related arousal, increased time spent in bed in the morning and daytime napping that can negatively impact and interfere with the duration and quality of night sleep.

The other potential mechanism for the other categories such as night shift workers would be linked to stress and jet lag at bedtime.

Regarding the BMI, most studies have focused on the relationship between obesity and primary headaches, which are very common disorders in the population. The relationship between headaches and obesity varies depending on the type of the primary headache. Patients with chronic migraines or episodic tension headaches are more likely to have a higher body mass index than those with episodic migraines or chronic tension headaches [3]. However, there have not been many studies devoted to morning headaches and body mass index, as it is difficult to differentiate between cause and effect, or simply a false relationship, our results also point in the same direction by showing that MH were not significantly associated with the BMI among our respondents.

For medical history we focused on the most common pathologies, high blood pressure, diabetes, cardiac pathologies, dyslipidemia, hypothyroidism, Parkinson's disease, Gastro-esophageal reflux disease and depression.

Unsurprisingly high blood pressure was the most involved in the occurrence of MH. It is known that MH have no precise location and are described as occurring early in the morning but to say that moderate hypertension predisposes to MH remains controversial, even though some studies suggest so.

One study compared MH in untreated hypertensive, treated hypertensive and normotensive patients and found that MH were more common in untreated high blood pressure and there was a significant improvement in MH after treatment.

However, controversial studies have not shown an obvious relationship between blood pressure fluctuations and MH. Nevertheless, the fact that MH are a little more common in hypertensive than in normotensive patients can be explained by the possible association of MH with other symptoms such as anxiety, which can be either a cause or a consequence of hypertension.

For cardiac pathologies, respondents with heart rhythm disorders were most likely to have MH; cardiac headache was included in the International Classification of Headaches [4]. It is a migraine headache, usually but not always aggravated by physical exercise, and which occurs in relationship with the onset of myocardial ischemia. MH were reported to be significant in respondents with heart rhythm disorders but there was no positive relationship with myocardial infarction. That said,linking MH to a cardiac origin requires careful documentation of the headache and its characteristics. Nevertheless, the MH complaint should prompt an evaluation of the underlying disease by the treating physician.

Against all odds, we did not find any link between MH and depression in our investigation. Yet depression can strongly influence the occurrence of MH, as has been reported in previous studies supporting that the relationship between MH and mood disorders is bidirectional [5]. However, the relationship between depression and MH remains poorly documented [6].

The association between headaches and hypothyroidism is also known. Headaches are one of the most common symptoms of hypothyroidism, which occur in about a third of patients. In the International Classification of Headaches, [4]. It was included in the secondary headache group. Headaches attributed to hypothyroidism can be daily and persistent [7]. The link between headaches and hypothyroidism appears to be real, but the bidirectionality of the association is unknown. As for their morning specificity there have not been

many studies that have given it the necessary importance, nevertheless our survey showed a significant rate of MH in respondents with hypothyroidism.

The prevalence of headaches in patients with idiopathic Parkinson's disease is lower than in the general population, 95% of patients with Parkinson's disease do not complain of headaches [8], and when they occur, they are located in the occipital region, particularly at the nape of the neck [9]. However, a recent study on migraines or tension headaches in patients with Parkinson's disease has found no association between the frequency of the headaches and the characteristics of Parkinson's disease, including neck stiffness or akinesia [10]. For MH, a study of patients with morning akinesia reported MH relieved by L-dopa [11]. And an improvement in both akinesia and MH. In our sample of respondents with Parkinson's disease, the association between morning headaches and Parkinson's disease was significant. Unlike the sleep-related GERD where the relationship with MH was not significant. However, sleep-related GERD is associated with sleep-related insomnia, early waking, micro-awakening, non restorative sleep, excessive daytime sleepiness and also daytime fatigue. All these sleep disturbances can promote the occurrence of MH.

In our study, MH were associated with sleep disorders, particularly among respondents who had difficulty falling asleep, maintaining sleepor had a fragmented sleep by frequent awakenings. The presence of even asingle indicator of insomnia was significant and represents a risk factor for the occurrence of MH. This risk was high in the presence of several indicators of insomnia. Similarly, respondents who slept less than 6 hours per night felt less often refreshed in the morning and therefore reported MH. The significant association between MH and insomnia indicators involving lack of sleep was not surprising as sleep deprivation is a well-established cause of MH [12]. This would explain the daytime sleepiness and inability to stay awake reported by more than half of the respondents who complained of headaches, which was a real hindrance to their daytime functioning. However, they were significant nap enthusiasts, which allowed them to counter the bad morning shape and improve alertness.

Obstructive sleep apnea (OSA)is caused by repeated obstruction of the upper respiratory tract that causes the airflow to stop completely or partially. Clinically OSA is associated with various symptoms including morning headaches. Although they are not as common as a non-restorative sleep and daytime sleepiness. They appear to be less frequent but last longer after waking [13, 14].

These headaches have been included in the international classification of headaches in the section of headaches attributed to a homeostasis disorder and headaches due to hypoxia and/or hypercapnia [4].

They are morning headaches, usually bilateral and last less than 4 hours, caused by sleep apnea. They disappear after effective treatment of the sleep apnea. The underlying mechanism by which OSA causes headaches is not clear. However, various factors such as sleep fragmentation, chronicity of the hypoxic events, hypercapnia, decreased cerebral blood flow, and transient increase in intracranial pressure appear to be implicated in the onset of the morning headaches and their intensity would be related to the severity of the OSA [15, 16].

A study with polysomnographic recordings dedicated to morning headaches in patients suffering from sleep apnea syndrome, have shown significant high MH frequencies that would be linked to a decrease in the total sleep duration, it's effectiveness and the amount of REM sleep and an increase in night awakenings during the previous night [17]. Our results showed that being apneic is positively related to MH. On the other hand, controversial studies have reported a lack of evidence that MH were associated with the severity of OSA or hypoxemia, the latter not clearly predisposing to MH [18].

With regard to parasomnias, we were interested in sleepwalking, which is a slow wave sleep parasomnia with dissociated brain activity, favored by sleep deprivation.

Studies have shown that partial and total sleep deprivation increases hyperalgesia by decreasing pain perception thresholds [19] and the predominant role of slow-wave sleep and REM sleep in modulating pain perception [20]. Previous studies have shown the frequent association between sleepwalking with migraines, another study on sleepwalking pain showed that the lifetime occurrence of the headaches was strongly associated with sleepwalking [21], in the same study, patients suffering from both sleepwalking and headaches had more violent episodes of parasomnia than sleepwalkers without headaches did.

To our knowledge, not many studies have reported the frequency of MH in sleepwalkers and our results have shown that sleepwalking contributes to the occurrence of MH. However, the characteristics of the headaches and the frequency of the sleepwalking episodes were not included in the questionnaire.

We also looked at MH among respondents with REM parasomnias like nightmare disorder , whichconsists of troubling dreams that occur during REM sleep, wake up the sleeper and cause sleep disturbances; or RBD which is a parasomnia characterized by the absence of muscle atony during REM sleep. The subjects live their dreams, which are sometimes very restless, violent, often awakening, causing fragmented, poor qualitysleep. As for somniloquy, which is considered a variant of normal rather than a disease. It is a formulation of words or sounds during sleep. It can occur during slow or REM sleep, and therefore it can be idiopathic or associated with parasomnias such as RBD or sleepwalking. Despite the limited data available on

the relationship between REM sleep parasomnias and somniloquy with MH, their association was positive in our study.

As for MH in sleep-related motor disorders represented mainly by RLS and bruxism. RLS is a sensory-motor disorder, characterized by intense symptoms in the evenings and at night that can have an impact on the quality and quantity of sleep, and that causes difficulty in falling asleep or maintaining sleep, or the feeling of non restorative sleep. Sleep-related bruxism can occur in the morning with transient oro-facial pain associated with pain in the medial pterygoid muscles and masseter [22]. In our study, abnormal sleep-related movements like RLS and bruxism were also significantly associated with MH.

These results are in line with the medical literature, particularly regarding the RLS [2].

At the end of the study, various risk factors, which could favor the appearance of MH in our population,were identified: being a woman, having a comorbidity like diabetes or hypothyroidism, a late bedtime schedule, difficulty falling asleep, presence of apnea, parasomnias of slow sleep (sleepwalking, confusional awakening), REM sleep (nightmares) and somniloquy.

V. Conclusion

The relationship between sleep, its disorders and MH is multifactorial. Indeed, many of our respondents complained about MH co-existing with sleep disorders, but facing this comorbid association it was difficult to differentiate between cause and effectas we focused our study primarily on sleep disorders and whether or not there were MH present. The strength of our study was the size of our sample and the selection bias, as our results apply to a representative sample of the general adult population, without pre-screening beforehand. However, the limitation of our study is that it is basedon a subjective questionnaire when a diagnosis cannot be established by a subjective evaluation, and for these results to be clearer, a confirmation by studies using physical measures such as polysomnography, Ventilatory polygraphy and actimetry must be conducted. Notwithstanding the limitations, our results led us to the identification of several relevant characteristics of the profile of patients suffering from MH and therefore to a more refined semiological description of MH, which in the future will allow establishing operational diagnostic criteria that will likely change the management of patients with MH.

Conflict of interest

The authors state that they have no conflict of interest.

Contribution of the authors

Siham Bahbouh and Mohamed Karim Guerchani contributed to the elaboration of the study, the interpretation of the data and the writing of the article.

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