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ORIGINAL RESEARCH

Influence of Socio-Demographic, Occupational and Lifestyle Variables on Sleep Time

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Background: Socio-demographic, occupational and lifestyle variables influence total sleep time. Therefore, we aimed to evaluate the influence of those variables on sleep time, and to study risk factors of being a short sleeper.

Methods: The COVISTRESS international study is an online questionnaire using the secure REDCap® software. Total sleep time was evaluated using declared bedtime and time of awakening and was analyzed as a quantitative variable and as a qualitative variable.

Results: We included 549 respondents to the questionnaire, divided into 10-year age groups ranging from <30yo to ≥60yo. The mean quantity of sleep was 7.11±1.43 hours per night. Factors that reduce total sleep time were age (coefficient −0.19, 95CI −0.33 to 0.06), being an employee (−0.46, −0.85 to −0.06), working time (−0.18, −0.31 to 0.05), smoking ≥5 cigarettes/day (−0.5, −0.95 to −0.20), high stress at work (−0.64, −0.96 to −0.32) and at home (−0.66, −0.97 to −0.35). Being a student (0.61, 0.02 to 1.19), working less than 25h per week (0.57, 0.17 to 0.97) and telework (0.46, 0.02 to 0.89) increased total sleep time. The risk factors of being a short sleeper were age (odds ratio 1.27, 95CI 1.07 to 1.51), being an employee (2.58, 1.36 to 4.89), smoking ≥5 cigarettes/day (2.73, 1.54 to 4.84) and a high level of stress at work (2.64, 1.45 to 4.82) and at home (3.89, 2.25 to 6.63). Physical activity ≥2.5 hours/week tended to decrease the risk of being a short sleeper by 35%.

Conclusion: We demonstrated the concomitant impact of sociodemographic, occupational and lifestyle behavior on sleep, which may help to build efficient preventive strategy.

Keywords: total sleep time, sociodemographic variables, occupational variables, mental health

Introduction

Sleep is a significant component of physical and mental health, as well as overall well-being.[1–4] According to the expert panel of the National Sleep Foundation, it is not recommended to sleep less than 6 hours for young adults (18–25yo) and adults (26–64yo) and less than 5 hours for older adults (≥65yo).[5] In general, there is consensus that 6 hours of sleep or less is inappropriate to support optimal health in adults.[6] Very interestingly, the number of hours of sleep is also easily accessible and quantified through questionnaires. Sleep diaries have been universally used as the preferred method for

Received: 25 September 2024
Accepted: 16 January 2025
Published: 30 January 2025

collecting data over time on self-reported sleep.[7,8] Factors influencing the number of hours of sleep is a topic that is frequently studied in the literature. However, most studies assessed those factors separately. For example, some socio-demographic factors are known to be at risk of reducing total sleep time such as age[9,10] and parenting[11] but those studies did not control for occupational factors. In the same way, occupational factors such as having a shift work,[12–15] a high level of stress at work,[12] long working hours[16] and lifestyle factors such as smoking,[12] sedentary lifestyle,[17] overweight or obesity[12,18,19] and screen time[20–22] have been shown to be major variables influencing sleep time but did not control for sociodemographic. Moreover, sleep has numerous health consequences. The relationship between sleep time and global mortality is well known,[1,19] often described as a U-shaped association,[23] as well as for cardiovascular mortality.[24] However, few studies quantify the risk of decreased sleep time by combining factors.

Therefore, the objective of our study was to assess concomitantly sociodemographic occupational and lifestyle factors that could influence the number of hours of sleep and to highlight risk and protective factors.

Methods

Study Design

We conducted an international prospective observational study on the general population that started after the COVID-19 pandemic. We used a computerized anonymous questionnaire accessible by COVISTRESS.org and translated into nine languages. The aim of this questionnaire is to follow the evolution of populations, in particular on their stress levels, their perception of work and their lifestyle habits. More precisely, there is a main COVISTRESS questionnaire that is a general questionnaire covering a global overview of individuals and, at the end of the main questionnaire, there are 8 additional questionnaires called "To go further", including one on sleep. The COVISTRESS study began before the Covid pandemic and represents an international collaboration between several institutions (University Hospitals, Universities, Research Centers, Occupational Health). Data was collected between November 2020 and October 2021. The questionnaire was disseminated electronically using all means (mailing list of organizations, social media such as Facebook, Twitter or LinkedIn, flyers distributed in supermarkets, shops and medical offices). All participants were volunteers and gave their informed consent on the online platform from the moment they started answering the questionnaire. They were informed that their data would be used anonymously for research purposes. No incentives (monetary or otherwise) were offered to participants. We used the secure internet application REDCap® to build and manage the questionnaire, hosted by the University Hospital of Clermont-Ferrand. Further details on the questionnaire can be found in the Checklist for Reporting Results of Internet E-Surveys (Supplementary Table 1). This study was conducted in accordance with the Declaration of Helsinki and was ratified by the French Ethical Committee South-East VI (Clinicaltrials.gov NCT04538586).

Participants

No inclusion or exclusion criteria were established for this study. No age limit was required.

Outcomes: Instrument Survey

Number of hours of sleep was measured with the use of declared bedtime and time of awakening. All the data are provided by the participants through the COVISTRESS self-questionnaire.

Secondary outcomes were sociodemographic: age (≤45yo vs >45yo and 10-year age groups from <30yo to ≥60yo), sex (men vs women), marital status (in a relationship vs other), parenthood (no child vs ≥1 child), graduation level (≤high school, undergraduate, master degree, doctorate), number of inhabitants (≤5000, 5000–50,000, >50,000). Occupational characteristic variables were occupation (superior, intermediary, entrepreneur, employee, student, looking for a job, retired), declared working time per week (<25h, 35h, 45h, ≥50h), declared percentage of telework (0%, 1–50%, 50–99%, 100%), level of stress at work was measured using a visual analog scale (low level of stress <50/100, intermediate 50–80, high >80).[25] Visual analog scales for stress is a common validated tool to assess the level of stress.[26] Participants can simply place a cursor corresponding to their level of stress on a horizontal, non-calibrated line of 100 mm, ranging from very low (0) to very high.[27,28] Lifestyle behavior variables were level of stress at home also measured using an analog visual scale (<50, 50–80, >80), alcohol consumption was measured by the reported number of glasses consumed per day

(0–4 vs ≥5), in the same way, tobacco consumption was measured by the reported number of cigarettes consumed per day (0–4 vs ≥5), physical activity was measured by the reported number of hours of physical activity per week (≤2h30 vs ≥2h30), body mass index, calculated from weight and height (<18.5kg/m² insufficient, 18.5–25kg/m² normal, 25–30kg/m² overweight, >30kg/m² obesity), declared time spent sitting per night (≤6h vs >6h) and declared time spent on social media (0h, ≤40min, 40min-1h30, 1h30-3h, >3h).

Statistical Analysis

Statistical analyses were computed using STATA® software (v15, StataCorp, College Station, USA). Quantitative data were expressed as mean±standard deviation, and qualitative (categorical) data were expressed as a number (n) and as a percentage (%). A first descriptive analysis was carried out to assess the characteristics of the participants. Number of hours of sleep (quantitative variable) was analyzed using Student's *t* test or Wilcoxon-Mann–Whitney test if data were not normally distributed for 2-group comparisons and using an analysis of variance (ANOVA) or Kruskal–Wallis test if data were not normally distributed for comparisons of 3 or more groups. Number of hours of sleep was further dichotomized into less than or equal to 6 hours of sleep and more than 6 hours. Prevalence of people sleeping 6 hours or less and more than 6 hours (qualitative variable) was analyzed using Chi2 test. We then studied the relationships with the number of hours of sleep using a linear regression model to assess the factors favoring or reducing the number of hours of sleep per night. Results were expressed as a coefficient and 95% confidence intervals (95CI). Finally, we quantified the risk of sleeping 6 hours or less using a logistic regression model. The results were expressed in terms of odd ratio (OR) and 95CI. Regression analyses were both run in univariate or in multivariate analyses. A value of p ≤0.05 was needed for statistical significance.

Results

Participants

A total of 40,705 people responded to the general COVISTRESS questionnaire. There are also 8 additional questionnaires "To go further" at the end, including the "Sleep questionnaire". Of the 40,705 respondents, 873 responded to the detailed "Sleep questionnaire". We excluded those who did not answer the item "number of hours of sleep". Finally, we included 549 respondents (Figure 1). Most participants (92.8%) lived in France. Almost three-quarters of them were women (n = 395, 72.5%). The average age was 46.3±13.1 years old (yo), ranging from 17 to 78 yo. The mean quantity of sleep was 7.11±1.43 hours per night, and 18.6% of the respondents were short sleepers (<6 hours) (Figure 2).

Mean Sleep Time Depending on Sociodemographic, Occupational Characteristics and Lifestyle Behavior

Using the number of hours of sleep as a quantitative variable (mean sleep time), significant sociodemographic were age, education, and children. People over the age of 45 yo slept less (6.94±1.38 vs 7.29±1.48 hours per night, p = 0.002), as well as those with lower education (6.98±1.70 in ≤high school, 7.07±1.43 in undergraduates, 7.15±1.45 in master's degree, and 7.16±1.30 in doctorate, p = 0.002), those with children (6.99±1.45 vs 7.36±1.49 for those without children, p = 0.004), and a tendency for a shorter sleep in those in couple (7.04±1.35 vs 7.27±1.57, p = 0.08). Gender and number of inhabitants did not influence mean sleep time. Regarding occupational characteristics, retirees, employees, and intermediaries were among those who did not sleep much (respectively, 6.96±1.71, 6.67±1.43 and 6.95±1.44, p = 0.014). The average number of hours of sleep decreased with the working time per week (6.89±1.31 in the ≥50h vs 7.62 ±1.31 in the ≤25h, p = 0.006). Telework did not influence mean sleep time. People with a high level of stress at work (>80) slept less than people with a moderate or a low level of stress (6.67±1.47 vs 7.36±1.28 vs 7.31±1.42, p < 0.001). In the same way, considering parameters of lifestyle behavior, people with a high level of stress at home (>80) slept less than people with a moderate or a low level of stress (6.68±1.52 vs 7.12±1.33 vs 7.34±1.43, p < 0.001). Smoking ≥5 cigarettes a day reduced the average sleep time (6.60±1.61 vs 7.17±1.40, p < 0.001). Physical activity >2h30 per week increased average sleep time (7.26±1.45 vs 7.02±1.42, p = 0.042). Mean sleep time was shorter in overweight (6.96 ±1.37) and obese (7.01±1.70) compared with underweight (7.20±1.32) or normal weight (7.20±1.40) individuals (p < 0.001). There was no significance regarding alcohol use, time spent sitting or on social networks.

https://doi.org/10.2147/NSS.S495455

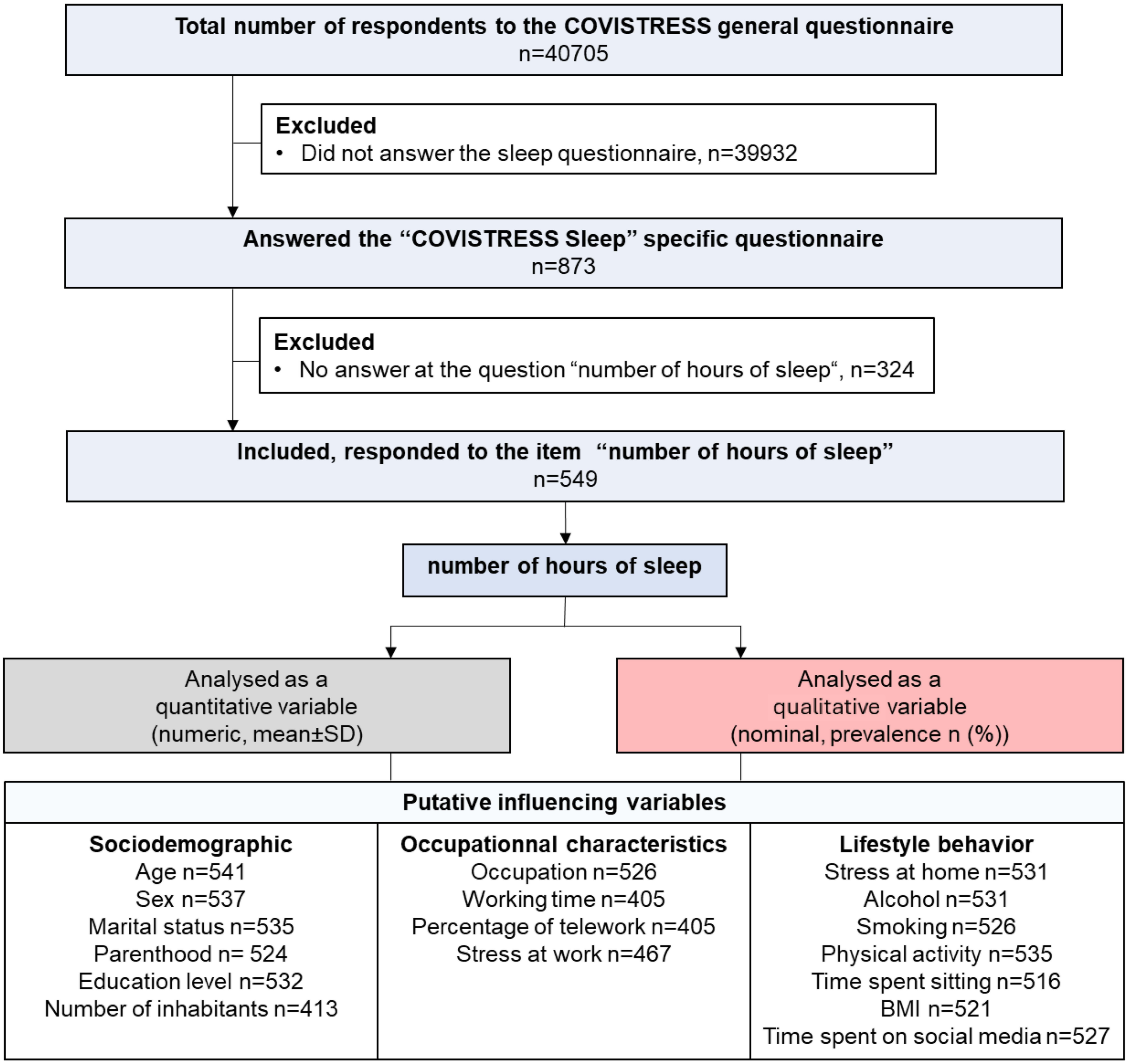

Figure 1 Flow chart. For quantitative analysis, "±" means more or less.

The prevalence of short sleepers (<6h) increased with age (6.9% in people <30 yo, 18.6% in the 30–40 yo, 16.2% in the 40–50s, 24.8% in the 50–60s, 21.7 in >60 yo, $p = 0.022$), stress at work (13.6% and 12.8% for people with a low and intermediate stress, and 29.5% for those high level of stress) and stress at home (11.6% for the low-stress category, 17.5% for intermediate stress, and 33.9% for high stress) ($p < 0.001$). The prevalence of short sleepers is higher in employees (31.8%) than in people looking for a job (26.9%) and intermediate occupations (23.7%) ($p = 0.005$). Smoking more than 5 cigarettes per day increased the prevalence of being a short sleeper (34.92% vs 16.42%, $p < 0.001$). There was no difference in the prevalence of short sleepers depending on gender, education level, marital status, parenthood, number of inhabitants, alcohol use, physical activity, body mass index, time spent sitting, time spent on social networks, working time and percentage of telework (Table 1 and Figure 3).

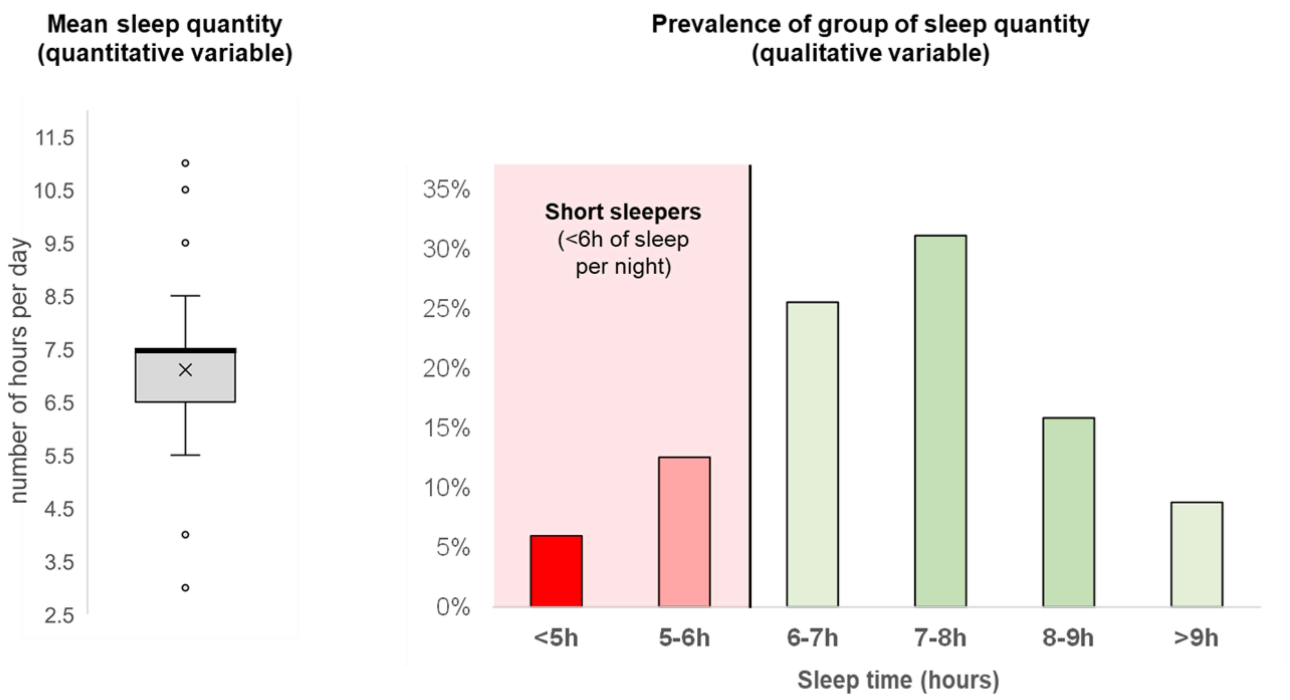

Figure 2 Overall total sleep time, as a quantitative variable (box and whisker plot) and as a qualitative variable (prevalence of sleeping <4h, 4–5h, 5–6h, 6–7h, 7–8h, 8–9h, and >9h). In the box and whisker plot (total sleep time in grey), the lower and upper sides of the box are the lower and upper quartiles (Q1 and Q3). The box covers the interquartile interval (IQR), where 50% of the data is found. The horizontal line usually splits the box in two and is the median. In that case, the median is equal to Q3. The mean is indicated by a cross on the box plot. The whiskers are the two vertical lines outside the box, that go from the minimum to Q1 (the start of the box) and then from Q3 (the end of the box) to the maximum. The whiskers are the two vertical lines outside the box, that go from 1.5 IQR to Q1 (the start of the box) and then from Q3 (the end of the box) to the 1.5 IQR. Outliers are individuals lower and upper than the end of the whiskers (lower than Q1 - 1.5 IQR and higher than Q3 + 1.5 IQR) and are indicated by a circle.

Factors Influencing Total Sleep Time (as a Quantitative Variable)

Sociodemographic

The linear regression analysis showed that total sleep time decreased with age (coefficient −0.16, 95CI −0.25 to −0.07, $p = 0.01$) as well as a tendency for those with a child (−0.23, −0.49 to −0.02, $p = 0.07$).

Occupational Characteristics

Total sleep time was higher in people working <25h per week (0.57, 0.17 to 0.97, $p = 0.005$ vs working 35h/week) and logically sleep time decreased with the number of hours of work per week (−0.18, −0.32 to −0.05, $p = 0.006$ using working time as a quantitative variable). Total sleep time was also lower in people with a high level (>80) of stress at work (−0.64, −0.96 to −0.32, $p < 0.001$).

Lifestyle Behavior

Total sleep time was lower in people with a high level (>80) of stress at home (−0.66, −0.97 to −0.35, $p < 0.001$), in those smoking ≥5 cigarettes per day (−0.57, −0.95 to −0.2, $p = 0.003$), as well as a tendency for those drinking ≥5 glasses of alcohol per week (−0.28, −0.60 to −0.04, $p = 0.08$) and for those practicing less than 2h30 of physical activity per week (−0.24, −0.49 to 0.01, $p = 0.06$).

There was no influence of sex, marital status, education level, number of inhabitants, telework, time spent sitting, BMI and time spent on social media (Figure 4).

 https://doi.org/10.2147/NSS.S495455

Table 1 Characteristics of Population

	Number of Hours of Sleep					
	n	Quantitative Variable		Qualitative Variable		
		Mean±SD	p-value	≤6h	>6h	p-value
				n (%)		
Sociodemographic						
Age						
≤45y	255	7.29±1.48	**0.002**	41 (15.89)	217 (84.11)	0.14
>45	285	6.94±1.38		60 (20.83)	288 (79.17)	
Age in 10-year increments						
< 30y	73	7.67±1.33	**<0.001**	5 (6.85)	68 (93.15)	**0.022**
30–40y	101	7.13±1.42		19 (18.63)	83 (81.37)	
40–50y	127	7.18±1.40		21 (16.15)	109 (83.85)	
50–60y	144	6.78±1.36		36 (24.83)	109 (75.17)	
≥ 60y	96	7.03±1.54		21 (21.65)	76 (78.35)	
Sex						
Men	148	7.10±1.52	0.91	24 (16.00)	126 (84.00)	0.31
Women	389	7.11±1.41		78 (19.85)	315 (80.15)	
Education level						
< High school	68	6.98±1.70	**0.002**	17 (25)	51 (75)	0.20
Undergraduate	161	7.07±1.43		29 (18.01)	132 (81.99)	
Master degree	135	7.15±1.45		29 (21.48)	106 (78.52)	
Doctorate degree	168	7.16±1.30		24 (14.29)	144 (85.71)	
Marital status						
Single / widow	178	7.27±1.57	0.08	31 (17.4)	147 (82.6)	0.65
In a relationship	357	7.04±1.35		68 (19.1)	289 (80.9)	
Parenthood						
No child	167	7.36±1.49	**0.004**	23 (13.77)	144 (86.23)	0.07
≥ 1 child	357	6.99±1.38		73 (20.45)	284 (79.55)	
Number of inhabitants						
≤ 5000	152	7.22±1.38	0.47	25 (16.23)	129 (83.77)	0.79
5000–50000	119	6.96±1.45		23 (19.01)	98 (80.99)	
>50000	142	7.13±1.44		27 (18.88)	116 (81.12)	
Professional characteristics						
Occupation						
Superior	232	7.13±1.25	**0.014**	36 (15.25)	200 (84.75)	**0.005**
Intermediary	93	6.95±1.44		22 (23.66)	71 (76.34)	
Entrepreneurs	26	7.69±1.33		2 (7.41)	25 (92.59)	
Employees	63	6.67±1.43		20 (31.75)	43 (68.25)	
Students	25	7.74±1.16		0 (0)	25 (100)	
Looking for a job	25	7.34±2.09		7 (26.92)	19 (73.08)	
Retirees	60	6.96±1.71		13 (21.67)	47 (78.33)	
Working time (per week)						
≤ 25h	53	7.62±1.31	**0.006**	6 (11.32)	47 (88.68)	0.58
35h	178	7.05±1.24		33 (18.54)	145 (81.46)	
45h	94	6.96±1.35		19 (20.21)	75 (79.79)	
≥50h	80	6.89±1.31		14 (17.50)	66 (82.50)	

(*Continued*)

Table 1 (Continued).

	Number of Hours of Sleep					
	n	Quantitative Variable		Qualitative Variable		
		Mean±SD	p-value	≤6h	>6h	p-value
				n (%)		
Percentage of telework						
0%	224	6.98±1.31	0.17	41 (18.30)	183 (81.70)	0.63
1–50%	90	7.03±1.12		15 (16.67)	75 (83.33)	
50–99%	50	7.3±1.36		6 (12)	44 (88)	
100%	41	7.44±1.52		9 (21.95)	32 (78.05)	
Stress at work						
<50	132	7.31±1.42	**<0.001**	18 (13.64)	114 (86.36)	**<0.001**
50–80	172	7.36±1.28		22 (12.79)	150 (87.21)	
>80	163	6.67±1.47		48 (29.45)	115 (70.55)	
Lifestyle behavior						
Stress at home						
<50	224	7.34±1.43	**<0.001**	26 (11.61)	198 (88.39)	**<0.001**
50–80	177	7.12±1.33		31 (17.51)	146 (82.49)	
>80	130	6.68±1.52		44 (33.85)	86 (66.15)	
Alcohol (per day)						
0–4	435	7.17±1.41	0.08	77 (17.58)	361 (82.42)	0.40
≥5	96	6.89±1.50		21 (21.21)	78 (78.79)	
Smoking (per day)						
0–4	463	7.17±1.40	**<0.001**	77 (16.42)	392 (83.58)	**<0.001**
≥5	63	6.60±1.61		22 (34.92)	41 (65.08)	
Physical activity (per week)						
≤2h30	314	7.02±1.42	**0.042**	66 (21.02)	248 (78.98)	0.08
>2h30	209	7.26±1.45		31 (14.83)	178 (85.17)	
Time spent sitting (per day)						
≤ 6h	204	7.14±1.42	0.68	35 (17.16)	169 (82.84)	0.50
>6h	312	7.07±1.46		62 (19.50)	256 (80.50)	
Body mass index						
Underweight	27	7.20±1.32	**<0.001**	6 (22.22)	21 (77.78)	0.25
Normal	294	7.20 ±1.40		46 (15.44)	252 (84.56)	
Overweight	131	6.96±1.37		27 (20.30)	106 (79.70)	
Obesity	69	7.01±1.70		17 (24.64)	52 (75.36)	
Time spent on social network						
0h	72	6.9±1.42	0.58	14 (19.44)	58 (80.56)	0.37
≤ 40min	157	7.23±1.28		21 (13.38)	136 (86.62)	
40min-1h30	110	7.13±1.36		22 (20)	88 (80)	
1h30-3h	121	7.11±1.58		26 (21.49)	95 (78.51)	
>3h	67	7.02±1.60		15 (22.39)	52 (77.61)	

Notes: Bold p-values were significant (ie, less than 0.05). The gray color represents the number of hours of sleep in quantitative format, while the pink color represents this variable in qualitative format (≤6h or >6h).
Abbreviations: SWS, slow wave sleep; WASO, wake time after sleep onset; SOL, sleep onset latency.

Risk of Being a Short Sleeper <6 hours/Day (as a Qualitative Variable)

Sociodemographic

The risk of being a short sleeper increased by 27% per 10-year of age (OR = 1.27, 95CI 1.07 to 1.51, p = 0.007) and tended to increase by 61% for people who have a child (1.61, 0.97 to 2.68, p = 0.07). Having a doctorate degree tended to be a protective factor for being a short sleeper (0.50, 0.25 to 1.01, p = 0.052).

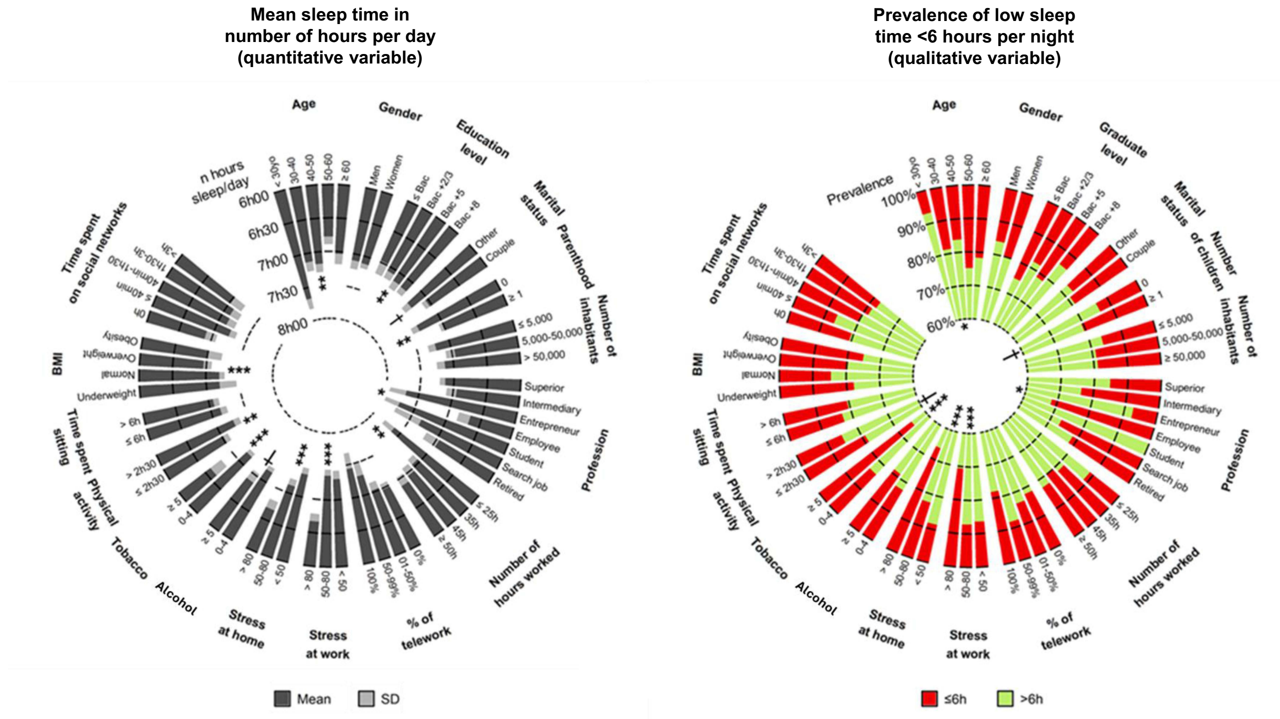

Figure 3 Total sleep time (as a quantitative and qualitative variable) depending on sociodemographic, occupational characteristics and lifestyle behavior. Number of hours of sleep (quantitative variable) were analyzed using Student's *t* test or Wilcoxon-Mann–Whitney test if data were not normally distributed for 2-group comparisons and using an analysis of variance (ANOVA) or Kruskal–Wallis test if data were not normally distributed for comparisons of 3 or more groups. Number of hours of sleep were further dichotomized into less than or equal to 6 hours of sleep and more than 6 hours. Prevalence of people sleeping 6 hours or less and more than 6 hours (qualitative variable) were analyzed using Chi2 test. Symbols are used according to the significance of the differences in the various tests. "†": p-value < 0.1, "*": p-value < 0.05, "**": p-value < 0.01 and "***": p-value < 0.001.

Occupational Characteristics

The risk of being a short sleeper was multiplied by 2.58 (1.36 to 4.89, p = 0.004) among employees and by 2.64 (1.45 to 4.82, p = 0.002) in people with a high level of stress at work (>80).

Lifestyle Behavior

A high level of stress at home (>80) was a risk factor for being a short sleeper (3.89, 2.25 to 6.73, p < 0.001). A moderate level of stress at home tended to be a risk factor for being a short sleeper (1.61, 0.92 to 2.84, p = 0.09) such as obesity (1.80, 0.95 to 3.36, p = 0.07) and practicing less than 2h30 of physical activity per week (1.54, 0.96 to 2.44, p = 0.08).

As for the linear regression, there was no influence of sex, marital status, number of inhabitants, telework, time spent sitting, and time spent on social media. Alcohol was also not significant (Figure 5).

Sensitivity Analysis

Linear and logistic regressions were also run in multivariate models with all variables and demonstrated similar findings (Supplementary Figures 1 and 2).

Discussion

Considering the importance of sleep on health, well-being, and economy, we demonstrated the impact of sociodemographic, occupational and lifestyle behavior on total sleep time in a population of adults and young adults.

Sleep as a Major Public Issue

Sleep is a topic that has been widely studied, notably the link between sleep disorders, total sleep time, and the resulting consequences. Sleep disorders such as insomnia, sleepwalking, or obstructive sleep apnea have an impact

Variables	Coefficient (95% CI)		p-value
Number of hour sleep - Quantitative variable			
Sociodemographic			
Age, per 10-years	-0,16	(-0,25 to -0,07)	**0.001**
Sex, men (vs women REF)	-0,01	(-0,28 to 0,27)	0.96
Single (vs couple REF)	-0,23	(-0,49 to 0,02)	0.071
Parenthood vs no children	-0,37	(-0,63 to -0,10)	**0.006**
Graduate level			
≤Highschool		Reference	
Undergraduate	0,09	(-0,32 to 0,49)	0.67
Master degree	0,16	(-0,25 to 0,58)	0.44
Doctorate	0,17	(-0,23 to 0,58)	0.40
Number of inhabitants			
≤5000		Reference	
5000-50000	-0,26	(-0,60 to 0,08)	0.14
50000-1million	-0,09	(-0,42 to 0,23)	0.57
Setting characteristics			
Occupation			
Superior		Reference	
Intermediary	-0,18	(-0,52 to 0,16)	0.30
Entrepreneur	0,56	(-0,16 to 1,13)	0.057
Employee	-0,46	(-0,85 to -0,06)	**0.023**
Student	0,61	(0,02 to 1,19)	**0.042**
Looking for job	0,21	(-0,38 to 0,79)	0.49
Retired	-0,18	(-0,57 to 0,23)	0.39
Working time, hours per week			
Categorical variable			
35h		Reference	
<25h	0,57	(0,17 to 0,97)	**0.005**
45h	-0,09	(-0,41 to 0,24)	0.59
≥50h	-0,16	(-0,50 to 0,18)	0.37
Continuous variable	-0,18	(-0,32 to -0,05)	**0.006**
% of telework			
0%		Reference	
1-50%	0,05	(-0,27 to 0,37)	0.77
50-99%	0,32	(-0,08 to 0,72)	0.12
100%	0,46	(0,02 to 0,89)	**0.038**
Stress at work			
< 50		Reference	
50-80	0,05	(-0,27 to 0,36)	0.77
> 80	-0,64	(-0,96 to -0,32)	**<0.001**
Lifestyle behavior			
Stress at home			
< 50		Reference	
50-80	-0,22	(-0,50 to 0,06)	0.12
> 80	-0,66	(-0,97 to -0,35)	**<0.001**
Alcohol, ≥5 glasses/d (vs 0-4)	-0,28	(-0,60 to 0,04)	0.083
Tobacco, ≥5 cig/d (vs 0-4)	-0,57	(-0,95 to -0,20)	**0.003**
Physical activity, >2h30/w (vs≤2h30)	0,24	(-0,01 to 0,49)	0.058
Time spent sitting, >6h/d (vs ≤6h)	-0,06	(-0,32 to 0,19)	0.607
Body mass index			
Normal		Reference	
Insuficient	0,01	(-0,56 to 0,57)	0.98
Overweight	-0,22	(-0,52 to 0,07)	0.13
Obesity	-0,19	(-0,56 to 0,19)	0.33
Time spent on social media, per day			
0h		Reference	
≤ 40min	0,32	(-0,07 to 0,73)	0.11
40min-1h30	0,22	(-0,20 to 0,65)	0.31
1h30-3h	0,21	(-0,21 to 0,62)	0.33
> 3h	0,11	(-0,36 to 0,59)	0.64

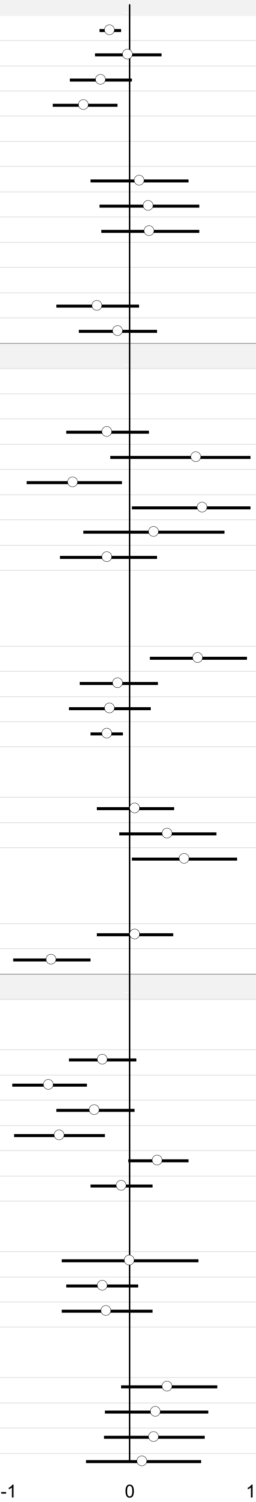

Figure 4 Factors influencing number of hours of sleep (univariate linear regression – see Supplementary Figure 1 for multivariate linear regression). Bolded p-values are less than 0.05 and are significant.

Variables	Odds ratio (95CI)		p-value
Sleeping >6 hours per night	Reference		
Sleeping <6 hours per night			
Sociodemographic			
Age, per 10-years	1,27	(1,07 to 1,51)	**0.007**
Sex, men (vs women REF)	0,77	(0,47 to 1,27)	0.31
Single (vs couple REF)	1,12	(0,70 to 1,78)	0.65
Parenthood vs no children	1,61	(0,97 to 2,68)	0.067
Graduate level			
≤Highschool		Reference	
Undergraduate	0,66	(0,33 to 1,3)	0.23
Master degree	0,82	(0,41 to 1,63)	0.57
Doctorate	0,50	(0,25 to 1,01)	0.052
Number of inhabitants			
≤5000		Reference	
5000-50000	1,21	(0,65 to 2,26)	0.55
50000-1million	1,20	(0,66 to 2,19)	0.55
Setting characteristics			
Occupation			
Superior		Reference	
Intermediary	1,72	(0,95 to 3,12)	0.074
Entrepreneur	0,44	(0,1 to 1,96)	0.28
Employee	2,58	(1,36 to 4,89)	**0.004**
Student		(to)	
Looking for job	2,05	(0,8 to 5,22)	0.13
Retired	1,54	(0,76 to 3,12)	0.23
Working time, hours per week			
Categorical variable			
35h		Reference	
<25h	0,56	(0,22 to 1,42)	0.22
45h	1,11	(0,59 to 2,09)	0.74
≥50h	0,93	(0,47 to 1,86)	0.84
Continuous variable	1,1	(0,84 to 1,44)	0.47
% of telework			
0%		Reference	
1-50%	0,89	(0,46 to 1,71)	0.73
50-99%	0,61	(0,24 to 1,52)	0.23
100%	1,25	(0,56 to 2,83)	0.58
Stress at work			
< 50		Reference	
50-80	0,93	(0,47 to 1,81)	0.83
> 80	2,64	(1,45 to 4,82)	**0.002**
Lifestyle behavior			
Stress at home			
< 50		Reference	
50-80	1,61	(0,92 to 2,84)	0.095
> 80	3,89	(2,25 to 6,73)	**<0.001**
Alcohol, ≥5 glasses/d (vs 0-4)	1,26	(0,73 to 2,17)	0.4
Tobacco, ≥5 cig/d (vs 0-4)	2,73	(1,54 to 4,84)	**0.001**
Physical activity, >2h30/w (vs≤2h30)	0,65	(0,41 to 1,04)	0.076
Time spent sitting, >6h/d (vs ≤6h)	1,17	(0,74 to 1,85)	0.5
Body mass index			
Normal		Reference	
Insuficient	1,56	(0,6 to 4,09)	0.36
Overheight	1,39	(0,82 to 2,36)	0.21
Obesity	1,8	(0,95 to 3,36)	0.070
Time spent on social media, per day			
0h		Reference	
≤ 40min	0,64	(0,3 to 1,34)	0.24
40min-1h30	1,03	(0,49 to 2,19)	0.93
1h30-3h	1,13	(0,55 to 2,34)	0.73
> 3h	1,19	(0,53 to 2,71)	0.67

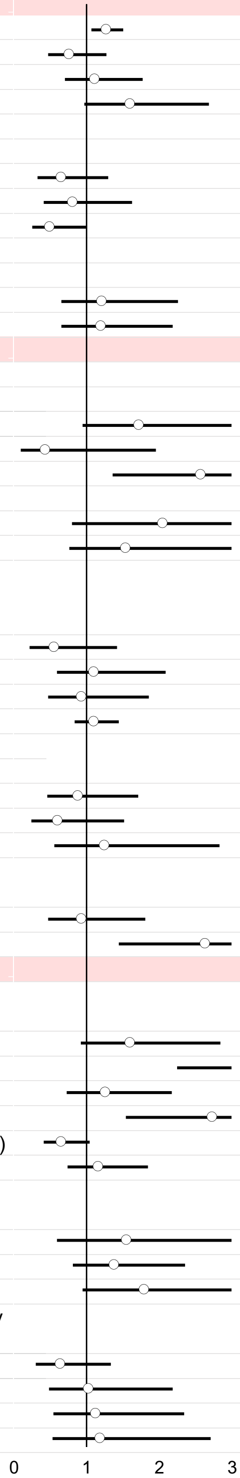

Figure 5 Factors influencing prevalence of sleeping less than 6 hours (univariate logistic regression – see Supplementary Figure 2 for multivariate logistic regression). Bolded p-values are less than 0.05 and are significant.

on total sleep time. Indeed, some sleep disorders decrease total sleep time, while others prolong it.[29–32] Short sleep time also increases the risk of multiple pathologies. Compared to people with recommended total sleep time – despite variations between studies in the reference group –, short sleepers have a risk increased by 11% for cardiovascular diseases in general,[33] by 20–32% for hypertension,[34,35] by 20% for incident myocardial infarction,[36,37] by 45% for obesity,[38–41] by 28% to 109% for impairment glucose tolerance or type 2 diabetes,[42,43] and by 31% for anxiety or depression.[44,45] The evolution of society and labor organization significantly changed our lifestyle and increased the number of workers with staggered hours and sleep debt,[46] promoting excessive sleepiness and sleep deprivation. Public health studies showed that sleepiness at the wheel and other risks associated with sleep are responsible for 5% to 30% of road accidents.[46] Lack of sleep produces deficits in memory consolidation and plays an important role in brain plasticity,[47–50] including among children and teenagers.[51,52] In a study across five different countries (US, UK, Germany, Japan and Canada), insufficient sleep also resulted in lower productivity levels and higher risk of mortality. The economic cost for those five countries were estimated up to $680 billion of economic output every year.[12] Through its impact on health, wellbeing and the economy, sleep has become a public and economic health issue.[53]

Sociodemographic

Age is a major factor influencing total sleep time. A systematic review from the National Sleep Foundation (USA) found that the amount of sleep needed is strongly related to age (8–10 hours for teenagers, 7–9 hours for young adults and adults, and 7–8 hours for older adults).[5] We confirmed the decrease in the number of hours of sleep with age,[5,9,10,54,55] however we retrieved an average sleep time far below the amount of sleep needed. Despite primary sleep disorders, sleep loss in older adults is mainly multifactorial, linked with medical and psychiatric comorbidities, disruption of the circadian rhythm, and changes in hormones (GH, cortisol, melatonin, sex hormones), lifestyle, social and environmental factors.[9] Gender does not influence sleep time in our study. In the literature, the relationship between gender and sleep duration is rather controversial; however, it tends to show shorter sleep durations among women.[56–58] They tend to go to bed earlier and wake up earlier,[59–61] which could lead to a desynchrony between circadian timing and sleep behavior.[62,63] We also did not find any significant influence of marital status on sleep time, yet a study reported that married people more likely reported a normal total sleep time (7–9h per day) compared with separated, divorced or widowed people.[64] It should be noted that both the form and quality of marital relationships are associated with sleep health.[65] We demonstrated that parenting is linked with shorter sleep time. In the literature, this link is more pronounced for women, more precisely for those with one child, particularly under 5 years old.[11] Despite no studies linked level of education and sleep, we found that having a doctorate degree tended to be a protective factor for being a short sleeper. Our study did not show any relationship between the number of hours of sleep and number of inhabitants; however, a study found that in areas with higher population density (cities >100 000 people), there is a shorter sleep time of about 10 minutes compared to communities <5000 inhabitants.[66] Many studies also highlighted the impact of neighborhood on sleep.[67–69]

Occupational Characteristics

In our study, employees and retirees slept the least, in accordance with literature.[5,13,14,54] Several factors may explain the short sleep time of employees such as a strenuous labor conditions (eg high workload[70] and shiftwork[12–15]) or poorer lifestyle behaviors (eg smoking,[71,72] low leisure physical activity[70,73] and less healthy diet).[73] The short sleep time in retirees may be mainly explained by the multifactorial influence of age, as explained before.[9] In accordance with literature, we showed that longer working time tended to decrease duration of sleep. Work schedules interfering with conventional sleep hours were associated with shortening of sleep as well as a rearrangement of the sleep architecture.[74] Also, longer working hours are associated with poorer mental health status and increasing levels of anxiety and depression symptoms, ie two symptoms known to cause sleep disturbances.[16] We also showed that 100% telework was linked with longer sleep time. Despite not being assessed in our study, long commuting time to work was correlated with shorter sleep time.[12] Some side effects of telework on sleep should also be reported, such as the lack of a clear separation between work and private life, resulting in working late at night, stress, loss of regular professional and social relation, and finally sleep dysregulation.[75] Lastly, we found that high level of stress at work was a risk factor for a shorter sleep time. People reporting unrealistic time pressure and stress at the workplace sleep on average 8 minutes less per day than those reporting low levels of time pressure.[12]

Lifestyle Behavior

A high level of stress at home is an important risk factor of short sleep time. Bedtime stress was related to decreased sleep efficiency and increased wakefulness.[76] We found that alcohol tended to reduce total sleep time. Interestingly, a single dose of alcohol reduces sleep onset latency, consolidating sleep in the first part of the night, but with more disruption in the second part.[77–79] In line with literature,[12] smokers more likely report shorter total sleep time. Smoking increased sleep latency, daytime sleepiness, and sleep problems such as sleep disordered breathing, sleep apnea, and insomnia.[80–82] We showed that meeting guidelines for physical activity increased total sleep time.[83,84] The literature highlights the positive impact of physical activity on sleep, especially in people with known sleep problems.[85–87] Moreover, the benefits of physical activity on sleep are immediate: the days where people are more active are associated with longer total sleep time.[88] The relation between physical activity and sleep seems stronger in women.[87,89] Although we did not find any relation between time spent sitting and total sleep time, literature showed that sedentary behavior was associated with shorter total sleep time in adolescents[90] and with insomnia and sleep disturbance in adults,[17] regardless of physical activity.[91] We also showed that overweight and obesity decreased total sleep time, in line with literature.[12,18,19] The relation is also bidirectional, with sleep debt increasing body weight.[39–41] Although we did not find a relation between duration of sleep and time spent on social media, the literature is vast.[92–94] Excessive use of social media leads to chronic sleep deprivation, especially in adolescents.[95] Popularity on social media was also linked with shorter total sleep time and greater sleep insufficiency.[96] Social media can also interface with psychosocial development and mental illness in transitional-age youth.[97] Besides psychosocial aspects of social media on sleep, another mechanism involved could be the blue light exposure from screens that suppresses production of melatonin, particularly around bedtime, thereby delaying sleep onset latency and reducing sleep time and quality.[20–22,98]

Limitations

Despite interesting results, our study has some limitations. The number of respondents included in our study may seem small, which is why no inclusion or exclusion criteria were applied, even though many parameters can affect total sleep time. However, this is the first study assessing simultaneously the main influencing factors of total sleep time.[5,17,62,72] Moreover, the sample size was sufficient to show significant results for most influencing factors. Another limitation is the potential declarative biases due to the use of a self-report questionnaire, such as inaccurate estimates of total sleep time, whether intentional or not, as well as memory or perception biases regarding their total sleep time.[99,100] There may also be a bias related to self-monitoring, as the act of observing and recording one's sleep can alter behavior. But assessing repeatedly the number of hours of sleep using polysomnography on a large population would have been impossible.[8,27] Moreover, evaluation of total sleep time was validated with the use of declared bedtime and declared awakening time, and allows the inclusion of a larger number of respondents.[7,8] Another limitation is a possible selection bias as volunteers with sleep disorders may have been more interested by the questionnaire.[101–103] There could be a confusion bias as the use of screen may interfere with sleep,[20–22,98] and our online questionnaire may have attracted more likely screen users.[104] Our study may also suffer from a lack of representativeness,[105,106] however we gathered a large sample size promoting generalizability of our results. Similarly, a greater proportion of females answered, but it was not possible to control for gender imbalance, and women are also usually more prone to respond to questionnaires.[107–110] Our study is also cross-sectional, precluding longitudinal analyses. However, repetition of our study over the next years/decades may permit to follow the trend in the evolution of total sleep time, as well as the evolution of the weight of factors influencing total sleep time.[111,112] Such a follow-up may also be particularly interesting in the particular context of the COVID-19 pandemic and its putative influence on sleep disorders of populations.[113,114]

Conclusion

The influence of sociodemographic, occupational, and lifestyle variables on sleep time was never simultaneously assessed in the general population. Age, being an employee, working time, smoking, stress at work and at home were associated with a lower quantity of sleep. Leisure time physical activity, being a student, and telework appeared to increase sleep time. Knowing the role of sociodemographic, occupational, and lifestyle variables that influence sleep time may help to build efficient preventive strategy.

Data Sharing Statement

The original contributions presented in the study are included in the article/supplementary materials. The data can be provided upon reasonable request to authors Frederic Dutheil or Luc Vialatte.

Acknowledgments

This paper is based on the thesis of Chloe Saint Arroman. It has been published on the institutional website: https://uca.hal.science/dumas-03944903/. We would like to thank the entire COVISTRESS network for their help during the development and implementation of the COVISTRESS study (https://covistress.org). See Appendix 1 for the COVISTRESS network group.

Disclosure

The authors report no conflicts of interest in this work.

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