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Sleep and dream habits in a sample of French college students who report no sleep disorders

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Summary

There is a lack of up-to-date data on sleep and dream habits of college students. To fill in this gap, we used an online questionnaire sent to the student mailing lists of two major universities of Lyon (Lyon 1 and Lyon 2) for the recruitment of an functional magnetic resonance imaging study with sleep disorders as exclusion criteria. In the sample (1,137 French college students, 411 males, mean age = 22.2 ± 2.4 years, body mass index = 22.0 ± 3.2 kg m^{-2}), on average, the participants reported spending about 8 hr in bed during weekdays, 9 hr during the weekends, and 90.9% of them reported no difficulty falling asleep. Less than 0.4% of students reported to have sleep-walking episodes regularly, but nearly 7% reported regular sleep-talking episodes. The average dream recall frequency was about 3 mornings per week with a dream in mind. Dream recall frequency was positively correlated with the clarity of dream content and the frequency of lucid dreaming, and was negatively correlated with age. Fourteen percent of the students reported frequent lucid dreams, and 6% reported frequent recurrent dreams. We found a gender effect for several sleep and dream parameters, including dream recall frequency and time in bed, both of which were higher in women than in men. We have also observed differences between academic disciplines, namely humanities students (Lyon 2) reported spending more time in bed than sciences students (Lyon 1). These results confirm a gender difference for several sleep and dream parameters, and suggest a link between academic disciplines and sleep duration.

KEYWORDS
dream recall frequency, epidemiology, gender differences, sleep habits, students, survey

1 | INTRODUCTION

Recent years have witnessed a renewed interest in sleep and dreaming (Dijk, 2015). However, epidemiological investigations in healthy subjects combining questions on both sleep and dream habits are relatively rare. Such surveys are yet necessary to establish and keep up to date sleep and dream norms in the general population.

The college population is particularly interesting given its seemingly high prevalence of sleep difficulties (Buboltz et al., 2009; Curcio, Ferrara, & De Gennaro, 2006; Forquer, Camden, Gabriau, & Johnson, 2008; Lund, Reider, Whiting, & Prichard, 2010). For instance, in a sample of 1,125 American students (420 males), about one-third self-rated their overall sleep quality as fairly bad (Lund et al., 2010). In another American sample of 742 undergraduates students (220 males), about 20% complained of having difficulties falling asleep or having a disturbed night sleep three times or more a week (Buboltz et al., 2009). These alarming findings raise questions about the overall sleep quality in college students. These results are, however, not necessarily representative of the college students of all countries (or states), and more data need to be gathered from all around the world to have a more precise idea of which parameters might affect sleep in young adults in college. For instance, only few

up-to-date data on the sleep habits of European college students are available. Noteworthy, in a sample of 413 Estonian students (95 males), Veldi, Aluoja, and Vasar (2005) showed that only a small proportion of the students rated their overall sleep quality as poor (6%) or very poor (1%), a finding that suggests potential differences in sleep patterns between European and American students.

The dream habits of college students have been investigated, especially through the work of Michael Schredl, who extensively studied the dream patterns of German students. His results showed that the average weekly dream recall frequency (DRF; i.e. number of mornings per week with a dream recall) in the college population is about 3 (Schredl, Ciric, Götz, & Wittmann, 2003; $n = 444$, 68 males; Schredl & Fulda, 2005; $n = 196$, 53 males). This figure is higher than that observed in the general adult population (about one dream recall per week), an effect that can be explained in part by the well-known negative correlation between age and DRF (Schredl, 2008; $n = 931$, 435 males, sample representative of the German population). The frequency of lucid dreaming is also higher in students than in the general adult population, with approximately 80% of college students reporting having already experienced at least one lucid dream, versus 50% in the general population (Schredl & Erlacher, 2004; $n = 444$, 68 males; Schredl & Erlacher, 2011; $n = 919$, 422 males, sample representative of the German population). This finding is coherent with several results showing a correlation between DRF and lucid dreaming frequency (Schredl & Erlacher, 2004). However, it is important to note that most surveys on dream habits were conducted on psychology students, an academic field attended in a great majority by women (Schredl, Wittmann, Ciric, & Götz, 2003), and are therefore not necessarily representative of the student population. Some authors suggested indeed an effect of lifestyle on DRF (Schonbar, 1965), and several studies reported a small but consistent gender effect in sleep and dream habits (Beck, Richard, & Leger, 2013; Schredl & Reinhard, 2008).

In the present study we collected recent (i.e. 2016) sleep and dream habits from a large sample ($n = 1{,}137$) of French college students who applied for a functional magnetic resonance imaging (fMRI) study with sleep disorders as exclusion criteria. The sample has the advantage to gather students from various academic fields, and to be composed of one-third males ($n = 411$). The online questionnaire asked about habitual time of light extinction and awakening during the week and the weekend, difficulties to fall asleep, agitation during sleep, nap frequency, sleepwalking, sleep-talking, DRF, clarity of dream content, and frequency of lucid and recurrent dreams. Our hypotheses were as follows. First, given that participants filled in the questionnaire to apply for a study with sleep disorders as exclusion criteria, we expected to find a lower prevalence of sleep disturbances in our sample than in the previously mentioned studies. Second, we expected to reproduce the gender effect on sleep, and the age and gender effects on DRF previously reported. Finally, according to the lifestyle hypothesis, we expected to find an effect of academic discipline on sleep and dream parameters. Notably, we predicted a higher DRF in humanities students than in sciences students given that humanities students usually score higher on certain personality dimensions known to be positively associated with DRF (e.g. openness to experience; Bunevicius, Katkute, & Bunevicius, 2008; Schredl, Ciric, et al., 2003; Schredl, Wittmann, et al., 2003).

2 | MATERIALS AND METHODS

Data were collected in 2016 using an online questionnaire for the recruitment phase of an fMRI sleep study. The subjects were informed of the study through an announcement sent to the student mailing lists of Lyon 1 University (45,000 students, 54% female, dominant academic disciplines = sciences and medicine) and Lyon 2 University (30,000 students, 68% female, average age of students = 24 years old, dominant academic discipline = humanities). The English translation of the full announcement can be found in S1 File. These two universities include about 60% of the total population of students of Lyon. Inclusion criteria for this fMRI study were as follows: (1) being right-handed; (2) being 18–65 years old; (3) being of French mother tongue. Exclusion criteria were: (1) suffering from psychiatric, neurological or sleep disorders; (2) using psychotropic substances; (3) being pregnant; (4) having a ferromagnetic metal body implant. These criteria were clearly stated in the announcement. Along with basic sociodemographic variables (age, gender, height, weight, education, academic discipline), the online survey included the following questions.

1) What time do you usually go to bed and get up during weekdays?
2) What time do you usually go to bed and get up during weekends?
3) In general, you fall asleep: very easily, easily, quite easily, with difficulty, or with great difficulty?
4) On a scale of 1–10, how agitated is your sleep? (1 = not at all agitated, 10 = very agitated).
5) How often do you experience sleepwalking episodes? (never, rarely, sometimes, often).
6) How often do you talk during your sleep? (never, rarely, sometimes, often).
7) How often do you take a daytime nap? (never, rarely, sometimes, often).
8) How many days per week do you usually wake up with a dream in mind?
9) How many days per month do you usually wake up with a dream in mind?
10) How often do you have lucid dream(s) (i.e. dreams in which you are aware that you are dreaming)? (never, rarely, sometimes, often).
11) How often do you have recurrent dream(s) (i.e. dream experienced repeatedly)? (never, rarely, sometimes, often).
12) In general, how clear is the memory of your dream content? (very vague, vague, clear, very clear).

We collected 1,262 completed questionnaires (459 males, age range = 18–61 years, mean age ± SD = 22.75 ± 3.94 years). In order to be representative of the typical age range of a student population, participants older than 30 years were removed, leading to a final sample size of 1,137 (411 males, 726 females, mean age ± SD = 22.23 ± 2.36 years, female body mass index [BMI] = 21.8 ± 3.3 kg m^{-2}, male BMI = 22.4 ± 3.1 kg m^{-2}, education = 3.3 ± 1.8 years after high school).

A binomial logistic regression was performed to investigate the gender differences in sleep and dream habits. In order to be entered in the model, the frequency of sleepwalking and sleep-talking episodes, and the frequency of lucid and recurrent dreams were recoded as follows: Never→ 0; Rarely → 1; Sometimes → 2; Often → 3. The dream clarity scale was recoded using: Very vague → 0; Vague → 1; Clear → 2; Very clear → 3. The level of ease or difficulty to fall asleep was recoded using: Very easily → 0; Easily → 1; Quite easily → 2; With difficulty → 3; With great difficulty → 4.

Finally, we compared the sleep and dream habits of students as a function of the academic discipline. We partitioned the sample into two broad categories, namely students studying sciences at Lyon 1 university (i.e. hard sciences, technology, medicine, *n* = 594 students) and students studying humanities at Lyon 2 university (i.e. social sciences, literature, psychology, educational science, law school, *n* = 404 students). The 139 remaining students of the sample were not included in the analysis because they were issued from heterogeneous academic disciplines and/or a professional environment. As for the gender differences, we applied a binomial logistic regression to investigate the effect of the academic discipline on sleep and dream habits.

3 | RESULTS

3.1 | Sleep habits

The average time in bed was 7.90 ± 0.96 hr (range = 3.5–12 hr) during weekdays and 9.10 ± 1.13 hr (range = 4–13 hr, paired *t*-test = <0.001) during weekends. Sleep schedules during weekdays and weekends are reported in Figure 1. The peak bedtime was between 23:00 hours and 23:59 hours (43.4%) during weekdays, and between 00:00 hours and 00:59 hours during weekends (33.6%). The peak waking time was between 07:00 hours and 07:59 hours during weekdays (42.3%), and between 10:00 hours and 10:59 hours during weekends (30.0%). Noteworthy, we found a significant negative correlation between BMI and the time in bed during the weekdays, thus suggesting shorter sleep duration in students with high BMI (Figure 2).

About one-tenth reported having difficulty (*n* = 99, 8.7%) or great difficulty (*n* = 4, 0.35%) falling asleep. Conversely, the great majority of students reported falling asleep quite easily (*n* = 421, 37.0%) or easily (*n* = 429, 37.7%), and 184 (16.2%) reported falling asleep very easily. The mean sleep agitation score reported was low (3.3 ± 1.7). Regarding sleepwalking, only four students (0.35%) reported having regular episodes, while 986 (86.7%) of them reported never having episodes. The percentage of students reporting regular episodes of sleep-talking was higher (75 students, 6.6%), and only 315 respondents (27.7%) declared never having sleep-talking episodes. Finally, a total of 113 participants (9.9%) reported that they often took a nap, while 196 respondents (17.2%) reported that they never took a nap. Frequencies of naps, sleepwalking, sleep-talking, recurrent dreams and lucid dreams are reported in Figure 3.

3.2 | DRF

The mean DRF was 3.12 ± 1.78 days per week (i.e. the participants recalled a dream on average 3 mornings per week) and 12.84 ± 7.51 days per month. Fifty-eight participants (5.10%) reported not recalling any dream per week, and nine participants (0.79%) reported not recalling any dream per month. Opposite to this, 34 participants (3.0%) reported recalling a dream 7 mornings per week, and 29 participants (2.55%) reported recalling a dream every morning of the month.

Despite the narrow age range of our sample (18–30 years old), we were able to evidence a negative correlation between DRF (weekly estimation) and age (Figure 4a). Weekly DRF was positively correlated with the frequency of lucid dreams (Figure 4c), the clarity of dreams (Figure 4d) and the level of agitation during sleep

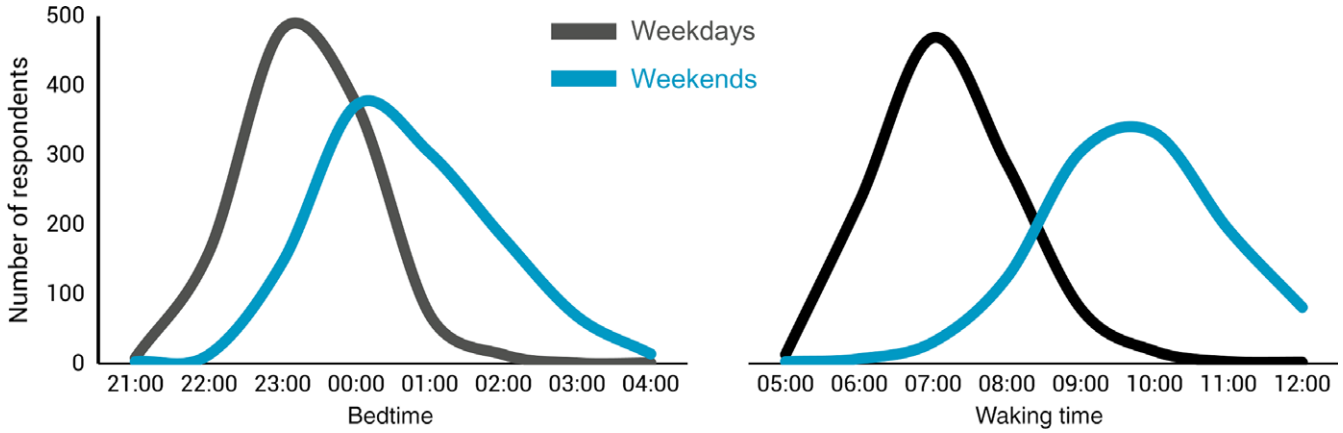

FIGURE 1 Bedtime (left) and waking time (right) distribution during weekdays (black lines) and weekends (grey lines)

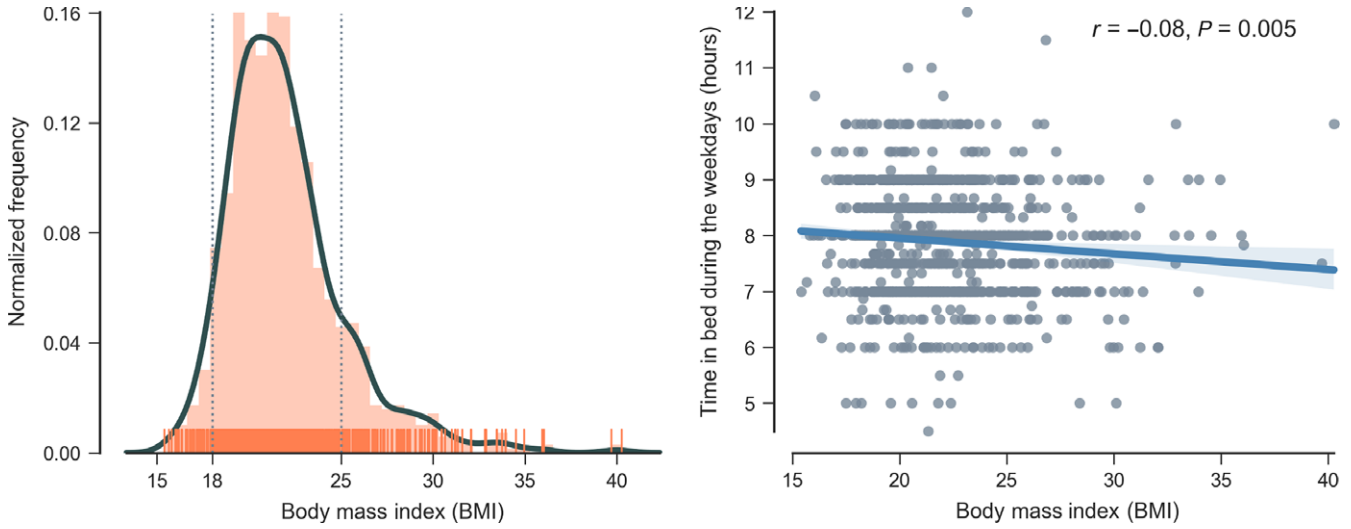

FIGURE 2 *Left*. Histogram of the BMI in our sample. The small orange vertical ticks represent individual observations, and the dark curve represents the fitted kernel density estimate. Vertical dashed lines highlight the limits of the normal weight category according to the international classification (i.e. 18–25 kg m^{-2}). *Right*. Significant negative correlation between BMI and the time in bed during the weekdays

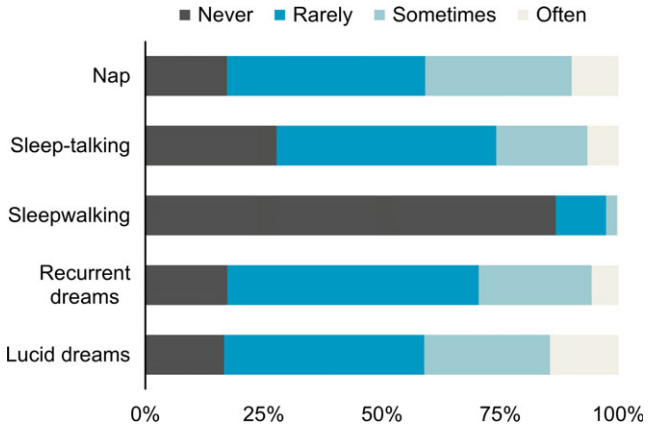

FIGURE 3 Frequencies of nap, sleep-talking, sleepwalking, recurrent dreams and lucid dreams in the sample

(Pearson r = .08, p = .008). We observed neither an effect of the academic field on DRF, nor a significant correlation between DRF and education level (Figure 4b).

3.2.1 | Clarity of dreams

Thirty-five participants (3.1%) reported that the usual clarity of their dreams was very vague. By contrast, 75 participants (6.6%) reported that their dreams were usually very clear. The great majority of respondents (n = 705, 62.0%) reported that their dreams were usually clear.

3.2.2 | Frequency of lucid and recurrent dreams

A lucid dream is a dream during which the dreamer is aware of dreaming. In our sample, 165 participants (14.5%) reported that they often had lucid dreams, while 189 participants (16.6%) reported that they never had a lucid dream (Figure 3). From these figures, it could be inferred that about 83% of the participants have already experienced a lucid dream at least once.

A recurrent dream is a dream that is experienced repeatedly. In our sample, 65 participants (5.7%) reported that they often had recurrent dreams, while 197 participants (17.3%) reported that they never had a recurrent dream (Figure 3), meaning that approximately a little more than 80% of the participants had already experienced recurrent dreams at some point in their lives.

3.3 | Gender differences

Table 1 depicts the summary of the binomial logistic regression for gender differences. One major assumption of binomial logistic regressions is that there should be no high inter-correlations (multicollinearity) among the predictors. Because the monthly-estimated and weekly-estimated measures of DRF were highly correlated (Pearson's r = .96, p = <.001), and given that weekly DRF is most commonly used in the literature, we chose to enter only this latter one as a predictor in the regression model. Results showed that time in bed, frequency of nap and weekly DRF were all significant predictors of gender. As compared with men, women reported spending more time in bed (during both weekdays and weekends), taking naps more often and having a higher weekly-estimated DRF. Women also tended to have more difficulties falling asleep and more frequent episodes of sleepwalking. Finally, the frequency of lucid dreams tended to be higher in men, while the frequency of recurrent dreams tended to be higher in women.

3.4 | Academic fields differences

Table 2 depicts the summary of the binomial logistic regression for academic discipline differences. Age, gender and time in bed were all

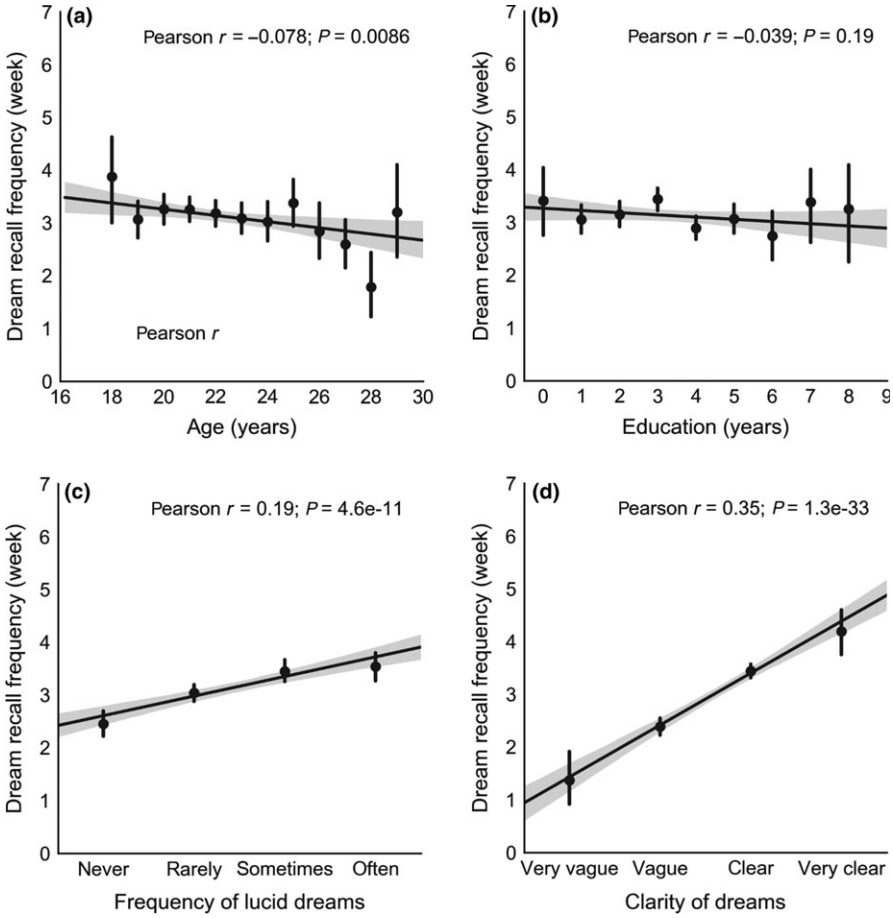

FIGURE 4 Correlations between DRF (number of mornings per week with a dream in mind), and (a) age, (b) education level, (c) frequency of lucid dreams, (d) clarity of dream memory. Error bars represent 95% confidence intervals

significant predictors of the academic discipline. There were more female students in humanities than in sciences, and the overall age of students in humanities was higher than in sciences. Humanities students reported spending more time in bed during both the weekdays and weekends (but the effect size of the difference for the weekends was very small). No differences were found regarding dream parameters.

4 | DISCUSSION

We took advantage of the recruitment questionnaire for an fMRI sleep study (with sleep disorders as an exclusion criteria) to perform an epidemiological survey of the sleep and dream habits of a large sample of French college students from Lyon University.

4.1 | Sleep habits in the sample

As expected given the announcement, the majority of students reported no difficulty falling asleep. Among this population of self-reported healthy sleepers, we observed an overall low score of agitation during sleep. The prevalence of parasomnias (i.e. sleepwalking and sleep-talking) was low. The average time in bed during weekdays was almost 1 hr longer in our study (7 hr 54 min) than in Taiwanese students (6 hr 59 min; Tsai & Li, 2004), and was equivalent to two studies carried out on American students (7 hr 57 min in Buboltz et al., 2009; 7 hr 45 min in Lund et al., 2010). Consistent with several studies, we have found that the average time in bed was about 1 hr longer during weekends as compared with weekdays, suggesting that, to some extent, students suffer from sleep deprivation during the weekdays. Nevertheless, it is important to note that the average time in bed during both weekdays and weekends was within the normal range (i.e. 7–9 hr per night; Hirshkowitz, 2004). The little or infrequent sleep disturbances (about one-tenth reported difficulty falling asleep) reported in this sample contrast with the results of previous studies on American students (Buboltz et al., 2009; Lund et al., 2010), which reported a high prevalence of sleep difficulties (about 22% and 34%, respectively). Interestingly, they are, however, consistent with a study on Estonian students that reported an even lower prevalence (7%) of sleep difficulties than the one we observed (Veldi et al., 2005). Our results therefore question the possibility of a lower sleep quality in American than in European students. Several factors could explain this possible difference, which would need to be tested on representative samples of the college population. First, in addition to the exclusion criteria for sleep disorders, the greater proportion of males in our study than in previous ones might result in a greater overall sleep quality as the prevalence of chronic insomnia was found to be higher in females than in males in a large French sample (Beck et al., 2013). Second, because obesity has been consistently associated with poor sleep quality (Gupta, Mueller, Chan, &

TABLE 1 Binomial logistic regression for gender differences in sleep and dream habits (n = 1,137)

Variable	Men (n = 411)	Women (n = 726)	SE	X^2	p	Cohen's d
Age (years)	22.41 ± 2.41	22.12 ± 2.32	−0.04	3.82	*.051*	0.12
Time in bed (hr, weekdays)	7.70 ± 0.99	8.02 ± 0.93	0.32	28.51	*<.001*	0.34
Time in bed (hr, weekends)	8.93 ± 1.17	9.19 ± 1.10	0.12	4.28	*.038*	0.23
Difficulty to fall asleep	1.34 ± 0.87	1.42 ± 0.87	0.14	3.53	*.060*	0.08
Sleep agitation	3.13 ± 1.62	3.39 ± 1.79	0.07	2.69	*.10*	0.15
Frequency of nap	1.24 ± 0.91	1.39 ± 0.85	0.24	9.90	*.002*	0.17
Frequency of sleepwalking	0.12 ± 0.41	0.19 ± 0.47	0.32	3.79	*.051*	0.14
Frequency of sleep-talking	1.04 ± 0.86	1.05 ± 0.85	−0.11	0.61	*.43*	0.01
DRF (weekly)	2.81 ± 1.71	3.29 ± 1.80	0.14	14.70	*<.001*	0.26
DRF (monthly)	11.52 ± 7.22	13.53 ± 7.57	–	–	–	0.27
Dream clarity	1.68 ± 0.65	1.73 ± 0.62	−0.04	0.14	*.710*	0.09
Frequency of recurrent dreams	1.09 ± 0.77	1.22 ± 0.78	0.14	2.98	*.084*	0.18
Frequency of lucid dreams	1.41 ± 0.93	1.37 ± 0.92	−0.16	3.70	*.054*	0.02

DRF, dream recall frequency; SE, standardized estimate.
Values represent means ± standard deviations. Frequencies of nap, sleepwalking, sleep-talking, recurrent dreams and lucid dreams are expressed using a recoded scale ranging from 0 (Never) to 3 (Often). Sleep agitation is scored on a 1–10 scale, where 1 means no agitation at all during sleep and 10 means a very agitated sleep. Difficulty falling asleep is expressed using a recoded scale ranging from 0 (very easy to fall asleep) to 4 (very difficult to fall asleep). For sleep agitation and difficulty to fall asleep, higher scores indicate more disturbances. Because of the highly-correlated nature of the weekly- and monthly-estimated measures of DRF, only the weekly-estimated DRF was entered into the regression model.

TABLE 2 Binomial logistic regression for academic differences in sleep and dream habits (n = 998)

Variable	Humanities (n = 404)	Sciences (n = 594)	SE	X^2	p	Cohen's d
Age (years)	22.41 ± 2.37	22.01 ± 2.19	−0.10	7.50	*.006*	0.17
Gender	0.79 ± 0.4	0.55 ± 0.5	−1.12	68.09	*<.001*	0.55
Time in bed (hr, weekdays)	8.12 ± 1.01	7.76 ± 0.86	−0.43	24.12	*<.001*	0.38
Time in bed (hr, weekends)	9.11 ± 1.14	9.10 ± 1.12	0.15	4.80	*.028*	0.01
Difficulty to fall asleep	1.40 ± 0.91	1.35 ± 0.84	−0.07	1.6	*.209*	0.05
Sleep agitation	3.29 ± 1.75	3.26 ± 1.71	−0.01	0.02	*.869*	0.02
Frequency of nap	1.31 ± 0.86	1.35 ± 0.89	0.12	2.20	*.138*	0.04
Frequency of sleepwalking	0.17 ± 0.44	0.16 ± 0.45	−0.01	0.01	*.968*	0.02
Frequency of sleep-talking	1.02 ± 0.86	1.07 ± 0.87	0.06	0.60	*.437*	0.06
DRF (weekly)	3.18 ± 1.79	3.09 ± 1.79	−0.31	0.01	*.902*	0.05
DRF (monthly)	12.95 ± 7.58	12.77 ± 7.51	–	–	–	0.02
Dream clarity	1.71 ± 0.61	1.72 ± 0.63	0.10	0.78	*.377*	0.02
Frequency of recurrent dreams	1.21 ± 0.78	1.14 ± 0.76	−0.08	0.38	*.535*	0.09
Frequency of lucid dreams	1.40 ± 0.91	1.38 ± 0.94	−0.05	0.20	*.657*	0.03

DRF, dream recall frequency; SE, standardized estimate.
Values represent means ± standard deviations. Gender is coded as 0 for male and 1 for female. Frequencies of nap, sleepwalking, sleep-talking, recurrent dreams and lucid dreams are expressed using a recoded scale ranging from 0 (Never) to 3 (Often). Sleep agitation is scored on a 1–10 scale, where 1 means no agitation at all during sleep and 10 means a very agitated sleep. Difficulty falling asleep is expressed using a recoded scale ranging from 0 (very easy to fall asleep) to 4 (very difficult to fall asleep). For sleep agitation and difficulty to fall asleep, higher scores indicate more disturbances. Because of the highly-correlated nature of the weekly- and monthly-estimated measures of DRF, only the weekly-estimated DRF was entered into the regression model.

Meininger, 2002; Sasaki et al., 2017), and given that the prevalence of obesity is higher in the USA than in Europe (Arroyo-Johnson & Mincey, 2016), it is possible that the differences in sleep quality between American and European students are the result of a healthier lifestyle and diet in European as compared with American students. Consistent with this hypothesis, the great majority of students in our sample had a BMI in the normal range (22.0 ± 3.2 kg m^{-2} on average), and we found a negative correlation between BMI and time in bed during the weekdays in our sample of self-reported healthy sleepers. Unfortunately, the BMI was

not reported in previous epidemiological studies on American students, but it seems promising to further investigate the influence of this parameter on sleep quality among college students. Future researches are needed to provide further evidence on possible cultural differences in sleep quality.

4.2 | Dream habits in the sample

Regarding dream recall, we found that on average the students of the sample reported recalling a dream about 3 mornings per week. This figure is higher than what was observed in a representative sample of the German adult population (Schredl, 2008), but similar to several studies in German student samples (3.5 dream recalls per week in Schredl & Fulda, 2005; $n = 196$, age = 24.8 ± 5.9 years; 2.75 in Schredl, Wittmann, et al., 2003; $n = 444$, age = 23.5 ± 5.70 years). This discrepancy between students and the general adult population could partly be explained by the well-known decrease in DRF with age (Schredl, 2008), which we were able to replicate in this study despite a narrow age range (18–30 years old). We also found a significant correlation between the clarity of the dream memory and DRF, suggesting that the more often one recalls his or her dreams, the clearer they are. This result is consistent with previous ones showing a significant correlation between dream report length and DRF (Schredl, 2000). Finally, we did not find a significant correlation between DRF and the number of years of higher education, a finding consistent with two studies that reported no association between DRF on one hand, and education level and socioeconomic status on the other hand (Schredl, 2007, 2008).

On another note, we observed that 80% of the participants had already experienced recurrent dreams at some point in their lives. This figure is consistent with several studies that reported a prevalence of 60%–75% of recurrent dreams in college students and young adults (Zadra, 1996). Similarly, approximately 83% of the participants had already experienced a lucid dream at least once in their lives, a figure consistent with previous studies on student population (e.g. 82% in Schredl & Erlacher, 2004). However, it should be noted that the definition of lucid dreaming given in the questionnaire did not include the ability to control the dream characters and narratives, but simply of being aware of dreaming during the dream. It is generally admitted that control over the dream represents the full extent of lucid dreaming and is more difficult to attain than the mere awareness of dreaming (LaBerge & Rheingold, 1991; Purcell, Mullington, Moffitt, Hoffmann, & Pigeau, 1986). Consequently, the proportion of participants having already experienced a lucid dream would have probably been lower if the definition of lucid dreaming involved the ability to exert some degree of control over the dream.

4.3 | Gender differences in sleep and dreams

Consistent with a previous survey on the French general population (Beck et al., 2013), we have observed that women reported a longer time in bed during weekdays (19 min more than men on average) and weekends (16 min more than men on average), and more difficulties to fall asleep. Noteworthy, Reyner and Horne (1995) obtained similar results by studying home-recorded logs in 400 British adults, i.e. an 18 min longer total sleep time in women than in men. This effect was, however, not significant in the *young* group (20–34 years), but appeared only in the older groups. In the same study, they also observed that women had a poorer subjective sleep quality and an increased intra-sleep wakefulness. A possible explanation for an increased time in bed in women could thus be that they spend more time in bed to compensate for increased intra-sleep awakenings. In coherence with this hypothesis, we found that women reported more difficulties falling asleep, more agitation during sleep and a higher frequency of daytime naps.

Furthermore, our results add a supplementary experimental argument to the numerous studies reporting a higher DRF in women than in men. Many factors could explain this gender difference in DRF. For instance, Schredl and Reinhard (2008) proposed that it was the result of a gender-specific dream socialization process during childhood. According to them, girls are encouraged more often than boys to talk about their dreams during their childhood, and might therefore develop a stronger interest in dreams, a factor consistently reported to be positively associated with DRF (Schredl, Wittmann, et al., 2003). However, there is currently a lack of longitudinal studies to support this hypothesis. Second, drawing from Schonbar's (1965) lifestyle hypothesis of dream recall, one can argue that the higher DRF in women could be the result of different personality and cognitive traits between men and women. This observation is supported by studies showing higher levels of neuroticism and creativity in women than in men (for review, see Baer & Kaufman, 2008; Schmitt, Realo, Voracek, & Allik, 2009), two traits that have been positively associated with DRF (Blagrove & Akehurst, 2000; Schredl, Wittmann, et al., 2003).

Third, the gender difference in DRF could be related to gender differences in sleep patterns. Indeed, as we have seen earlier, women tend to have increased intra-sleep wakefulness and poorer sleep quality. According to the arousal–retrieval model of dream recall (Koulack & Goodenough, 1976), the occurrence of a period of wakefulness during or immediately after a dream is necessary to encode the dream content into long-term memory. This model implies that nocturnal awakenings are positively associated with DRF, an assumption that has been experimentally supported using retrospective evaluation (Schredl, Wittmann, et al., 2003) and polysomnographic measures in high and low dream recallers (Eichenlaub, Bertrand, Morlet, & Ruby, 2014; Vallat et al., 2017). Accordingly, an increased intra-sleep wakefulness in women could be causally linked to an increased DRF. However, it should be emphasized that even though the gender effect in DRF was consistently found in several studies, the magnitude of this effect is generally small. Indeed, the effect size (Cohen's *d*) was 0.26 in the present study, and between 0.24 and 0.27 in Schredl and Reinhard's (2008) meta-analysis.

Second, the higher frequency of recurrent dreams in women than in men has previously been reported (Zadra, 1996), but is not

yet clearly understood. As for the differences in DRF, it might be related to different personality and cognitive traits between men and women. Finally, the finding that men have a higher frequency of lucid dreams than women should be taken cautiously as the effect size was very small (Cohen's $d = 0.02$), and other studies reported either the opposite effect (Schredl & Erlacher, 2011) or no gender difference (Schredl & Erlacher, 2004; Stepansky et al., 1998).

4.4 | Academic field, sleep and dreams

In the sample studied, humanities students reported spending more time in bed than sciences students during weekdays and weekends, even when age and gender confounds were controlled for. This might be explained by a lower number of courses per week and/or a different morning schedule of classes in humanities as compared with sciences. It may also be that the harsh competition in sciences (and especially medicine) encourages students to reduce their sleep duration in order to have more time available for studying. Another possible explanation, non-exclusive of the others, could be that humanities and sciences students may have different average lifestyles and personality traits (Hartmann, 1989; Schonbar, 1965). Specifically, humanities students may show a more positive attitude towards sleep than sciences students, and therefore allow themselves more time to sleep. Compatible with this hypothesis, Bunevicius et al. (2008) showed that humanities students scored higher than sciences students on certain personality dimensions (e.g. openness to experience), which have in turn been associated with longer sleep duration and increased DRF (Hartmann, 1989; Schredl, Ciric, et al., 2003).

This latter correlation between personality traits and DRF was the reason why we were expecting a higher DRF in humanities students than in sciences students. However, our results did not confirm this prediction. One possible explanation is that a higher level of academic stress and/or a higher frequency of nocturnal awakenings in sciences students could increase DRF and therefore compensate for the positive personality trait effect on DRF in humanities students. Indeed, both these factors have been consistently associated with increased DRF (Eichenlaub et al., 2014; Schredl, Wittmann, et al., 2003; Vallat et al., 2017). It would also be interesting to compare the diet, level of physical activities and recreational drug uses between humanities and sciences students, given that all these factors could potentially have an important effect on sleep and dream patterns.

4.5 | Limitations

Limitations arise from the fact that the survey was designed for the recruitment phase of an fMRI sleep study. This study provides thus novel and up-to-date information about the sleep and dream habits of college students who report no sleep disorders, but future studies are needed to provide such information in a representative sample of the college population and thus to be able to estimate the prevalence of sleep disorders and disturbances in French college students.

AUTHOR CONTRIBUTIONS

R. V. and P. R. designed the survey, R. V. collected, analysed the data and wrote the first draft. All authors were involved in the writing process.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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