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Lucid Dreaming: Not Just Awareness, but Agency

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ABSTRACT

During lucid dreaming (LD), dreamers are aware that they are dreaming and may be able to influence the oneiric content. There has been recent debate about the relative importance of the ability to influence the dream and having agency over the pure awareness of dreaming. To underline this, we examined the associations of lucid dreams without agency (LD−Ag) and lucid dreams with agency (LD + Ag) to sleep and mental health problems and long COVID during the pandemic. We collected data in 16 countries on four continents from May to December 2021 on 10,715 subjects. Logistic regression was performed to predict LD−Ag and LD + Ag, with a sample of 8133 participants. We found that 30% of the participants frequently knew they were dreaming during the pandemic. About half of those (17%) reported that they could influence their dreams. Female gender and anxiety symptoms were negatively associated with LD + Ag. Dream recall, nightmares, insomnia, dream enactment behaviour (DEB), sleep vocalisation, short and long COVID and PTSD were positively associated with LD + Ag. Old age, dream recall, nightmares and anxiety symptoms were positively associated with LD−Ag, while short sleep length, being an evening type, and short COVID were negatively associated with LD−Ag. The different associations for LD−Ag and LD + Ag suggest that they may be distinct sleep states. This is also the first study to show that both COVID-19 and long COVID are associated with LD.

1 | Introduction

Lucid dreaming (LD) happens when dreamers realise that they are dreaming and may be able to influence the oneiric content (Baird et al. 2019; LaBerge et al. 1981). This rare type of dreaming has often been connected to positive mental health outcomes (Doll et al. 2009; Stumbrys 2023) and even has been implemented as a means to treat distress and recurrent nightmares (De Macêdo et al. 2019; Holzinger et al. 2020; Yount et al. 2023). However, some researchers have pointed out that empirical findings are not that simple; contradictory results regarding the relationship between mental health and LD have been found (Aviram and Soffer-Dudek 2018). In one study, for example, LD was related to increased anxiety and depressive symptoms (Schredl et al. 2022).

These inconsistent findings might be explained by the ability to influence the oneiric content, which is often argued to be an essential feature of LD (Holzinger et al. 1998; Holzinger and Mayer 2020). It often happens that upon realising that one is dreaming, the dreamer awakens or cannot influence the dream plot (Aviram and Soffer-Dudek 2018; Mota-Rolim et al. 2013). Evidence points towards being able to influence the dream and therefore having agency being the key variable to explain heightened subjective well-being and lowered distress in the context of LD (Aviram and Soffer-Dudek 2018; Harb et al. 2016; Wolpin

For affiliations refer to page 12.

et al. 1992). Agency, or 'sense of agency', is the feeling of being in control of one's own actions (Haggard 2017; Rosen 2021). We therefore hypothesize that only dreams, in which one is aware of dreaming and able to influence the dream, are associated with positive mental health and better sleep quality. This implicates that solely realising that one is dreaming, without being able to influence the dream, will not be associated with positive mental health and increased sleep quality.

Following this approach, in this paper, we examine the difference between dreams in which the dreamer is aware of dreaming but has no agency in the dream (LD−Ag) and dreams in which the dreamer is aware of dreaming and can act volitionally (LD + Ag). As the data for this study were gathered during the COVID-19 pandemic, the effects of the pandemic, COVID-19, and long-COVID on LD−Ag and LD + Ag are also examined. There is evidence that COVID-19 can influence dreams and nightmares (Scarpelli, Nadorff, et al. 2022).

Our first and main hypothesis is that LD−Ag and LD + Ag have different associations with different important variables. Particularly, only LD + Ag is hypothesised to be associated with better sleep, fewer sleep problems, and better mental health. The second hypothesis is that long-COVID is a significant predictor of LD−Ag and LD + Ag even when controlling for other important predictors. Our third hypothesis is that LD−Ag and LD + Ag frequencies have changed due to the pandemic.

2 | Methods

This study is part of the second survey from the international COVID-19 Sleep Study (ICOSS) group. The detailed methods had been published elsewhere (Merikanto et al. 2022). Data collection was online, between May and December 2021, in the following 16 countries: Austria, Brazil, Bulgaria, Canada, Hong Kong/China, Croatia, Finland, France, Germany, Israel, Italy, Japan, Norway, Portugal, Sweden and United Sates. Participants completed the anonymous survey online via platforms including Redcap or Qualtrics. The survey was promoted in various ways, which resulted in slight variations in samples between countries/regions. For example, the United States sampled undergraduate students; whereas Italy marketed the survey to attempt to oversample participants with long-COVID. The study was conducted in accordance with the Declaration of Helsinki. All countries either obtained ethical approval or exemptions due to the anonymous nature of the survey. Participants had to give consent before starting the survey and had to be at least 18 years of age.

2.1 | Participants

Altogether, 15,859 participated in the online survey. As only five participants declared their gender as 'other', these were excluded from the analysis due to the small sample size. Further, participants from Canada, Hong Kong, and Israel ($n = 2063$) were excluded from the dataset because the questions about LD were not asked in these countries. Participants from the United States ($n = 934$) were also excluded, as the sample was largely skewed to young university students and not comparable to the general population samples from other countries. We further excluded all those who did not answer the questions about LD during the pandemic ($n = 2142$). To examine overall frequencies of LD−Ag and LD + Ag, we used this final sample of 10,715 participants. For further analysis and logistic regression models, we excluded all participants with missing values in all relevant variables. In this way, for the models predicting LD−Ag and LD + Ag, a sample of 8133 participants was used.

2.2 | Questionnaire

As the full questionnaire is already described in (Merikanto et al. 2022), we will only describe the questions used for this study. First, we asked about basic demographic information such as age, gender and country. Next, in two questions, participants were asked whether they have had COVID-19. At first, we asked if they had had an infection, and afterwards, if they had a positive COVID-19 test result. Only if they answered 'yes' to both of these questions were they treated as having suffered from COVID-19. Participants were then asked about various symptoms that they might have had, which are classified as symptoms of long-COVID. These included fatigue, shortness of breath or difficulty breathing, and/or chest pain, among others. The full list can be found in, for example, Scarpelli et al. (2023). We classified participants with at least one of these symptoms persisting at least 3 months after the infection as long-COVID, as defined by the WHO (Soriano et al. 2022). Participants who had had an infection but showed no long-lasting symptoms were classified as short-COVID.

We examined sleep quality and duration with questions specifically developed for this survey, as well as questions taken from the Basic Nordic Sleep Questionnaire (BNSQ) (Partinen and Gislason 1995). Dream recall, nightmare frequency, LD−Ag frequency and LD + Ag frequency were asked with one question for the time period during the pandemic and one before the pandemic.

For LD−Ag, we asked participants 'How often do you know you are dreaming while you are dreaming?'. For LD + Ag, we asked participants 'How often do you know you are dreaming while you are dreaming and can influence the dream?'. Response alternatives for both of these questions were 'Never or less than once a year', 'Less than once per month', less than once per week', '1-2 times per week', 'At least on 3 times per week'. For dream recall and nightmares, response alternatives were 'Never or less frequently than once per month', 'Less than once per week', 'On 1-2 days per week', 'On 3-5 days per week', 'Daily or almost daily'. Frequent dream recall was classified when participants stated to remember their dreams on at least 3 days a week (Ruby et al. 2022). Frequent nightmares were classified when participants stated that they experienced a nightmare at least once a week (Schredl and Göritz 2018). Due to the rarity of the phenomenon, participants were classified as experiencing LD−Ag or LD + Ag frequently, when they indicated that they experience them at least once a month (Ribeiro et al. 2020; Snyder and Gackenbach 1988). Due to the way the questions were formulated, LD−Ag might also include LD + Ag, as they were at least aware of dreaming and it was not whether they had to have agency or not. Therefore, having frequent LD−Ag might also

include frequent LD + Ag, but not exclusively. However, as the aim is to see, if these are two different phenomena, only those who reported frequent LD−Ag but not frequent LD + Ag, were classified as having frequent LD−Ag.

The personality trait Morningness-Eveningness was assessed with a single modified question taken from the 19-item Morningness-Eveningness Questionnaire (Horne and Ostberg 1976). The question stated 'Are you a morning- or evening type-person?' with the possible responses 'I am very alert/active in the morning and sleepy early in the evening (definitively morning person)', 'I am to some extent alert in the morning and sleepy in the evening (more morning than evening person), 'Neither morning nor evening person', 'I am to some extent alert in the evening and sleepy in the morning (more evening than morning person)', and 'I am very alert/active in the evening and sleepy in the morning (definitively evening person)'. Sleep talking, shouting, singing or laughing during sleep was evaluated with a single 5-point scale question. Response alternatives were 'Never or less frequently than once per month', 'Less than once per week', 'On 1-2 days per week', 'On 3-5 days per week', 'Daily or almost daily'.

Dream Enactment Behaviour (DEB) was examined with the REM-Sleep-Behaviour-Disorder Single-Question Screen (Postuma et al. 2012). Participants were asked if they had ever been told that they seem to 'act out their dream', while asleep, with possible responses 'Yes' or 'No'. In another question, participants were further asked, how often these symptoms appear on a 5-point scale. Response alternatives were 'Never or less frequently than once per month', 'Less than once per week', 'On 1-2 nights per week', 'On 3-5 nights per week', 'Every night or almost every night'. While some authors have used a weekly appearance of this behaviour as a significant cut-off (Liu et al. 2023), due to the small sample size fulfilling this criterion, any participants indicating to have acted out their dream were classified as having DEB.

Insomnia was assessed using the Insomnia Severity Index (ISI) (Bastien et al. 2001). A score of 10 or higher was used to indicate probable cases of Insomnia.

Possible sleep apnea was assessed using the STOP-questionnaire (Chung et al. 2008). Normally, the questions are asked as Yes/No questions, but for this survey, the questions were adapted to assess the frequency of the assessed symptoms. When participants indicated that they showed this behaviour 3 times a week or more often, the question was then reported as 'yes'. If a participant answered 'yes' to 2 or more questions on STOP, they were classified as having a high risk of obstructive sleep apnea (Chung et al. 2021).

To evaluate Depression and Anxiety, we used the Patient Health Questionnaire for Depression and Anxiety (PHQ-4) (Kroenke et al. 2009). The questionnaire was split up into two subscales, one for Depression and another for Anxiety. For both, a cutoff score of 3 or higher was used to indicate probable cases.

The Abbreviated Post-Traumatic Stress Disorder (PTSD) Checklist, comprised of two questions, was used to evaluate possible PTSD symptoms (Lang et al. 2012). These two questions are then summed up; a cutoff score of four or higher is used to indicate probable PTSD.

2.3 | Statistical Analysis

To investigate possible changes in LD−Ag and LD + Ag frequency during the pandemic compared to before the pandemic, we conducted McNemar and McNemar-Bowker tests.

To investigate the influence of different variables, especially COVID-19 and long-COVID, on LD−Ag and LD + Ag, we conducted logistic regression models with frequent LD−Ag/LD + Ag as dependent variables. To control for important variables, like dream recall and gender, we at first chose the variables to implement and control for based on current literature and our own experience. These were gender, age, dream recall, nightmares, insomnia, dream enactment behaviour, obstructive sleep apnoea (OSA), sleep duration, morningness–eveningness, singing, laughing, and shouting during sleep, short and long COVID, PTSD symptoms, anxiety symptoms, and depression symptoms. We further included the country in which the participant lived. Age was split into groups and implemented as an ordinal variable. Groups were 18–29, 30–39, 40–49, 50–59, 60–69, 70+ years old. Sleep duration was split into three groups: less than 6 h (short sleepers), 6–9 h (normal sleepers), and more than 9 h (long sleepers).

For the logistic regression models, we chose the included variables by stepwise backward selection using the AIC, likelihood-ratio tests, and Wald tests. For all the included variables, unadjusted odds ratios, as well as adjusted odds ratios given by the final model are provided. The final models were evaluated using area under the curve (AUC), McFadden Pseudo R^2, specificity, sensitivity, accuracy and precision. To evaluate the stability of the selected variables, we used bootstrap sampling and repeated the selection process 1000 times (Heinze et al. 2018). Statistical procedures were performed using R Statistical Software (v4.4.0) (R Core Team 2024).

3 | Results

We found that 3242 (30%) of the participants frequently, that is, at least once a month, knew they were dreaming while sleeping during the pandemic. Before the pandemic, 3037 (28%) frequently knew they were dreaming while sleeping ($p < 0.001$). During the pandemic, 1537 (14%) frequently experienced LD−Ag, knowing that they were dreaming while sleeping, but did not have volitional control during the dream. Before the pandemic, 1460 (14%) experienced LD−Ag frequently without the ability to influence the dream ($p < 0.01$). For LD + Ag, 1829 (17%) of the participants experienced this frequently during the pandemic, and 1722 (16%) experienced it frequently before the pandemic ($p < 0.001$). The exact answers are depicted in Table 1. While there is a significant difference between before and during the pandemic, this difference is small. There were prominent differences between countries, as can be seen in Figure 1. While in Sweden, over half of the participants (64%) reported frequently knowing they were dreaming while sleeping, in Japan, only 11% stated this. Frequencies in most of the countries

TABLE 1 | Comparisons of the two questions regarding dream awareness and influence.

	How often do you know you are dreaming while you are dreaming? ($p < 0.001$)		How often do you know you are dreaming while you are dreaming and can influence the dream? ($p < 0.001$)	
	Before the pandemic	**During the pandemic**	**Before the pandemic**	**During the pandemic**
Never or less than once per year	5105 (48%)	5116 (48%)	6923 (65%)	6924 (65%)
Less than once per month	2566 (24%)	2357 (22%)	2053 (19%)	1962 (18%)
Less than once per week	1218 (11%)	1214 (11%)	827 (8%)	816 (8%)
1–2 times per week	1012 (9%)	1097 (10%)	527 (5%)	585 (5%)
At least on 3 times per week	807 (8%)	931 (9%)	368 (3%)	428 (4%)

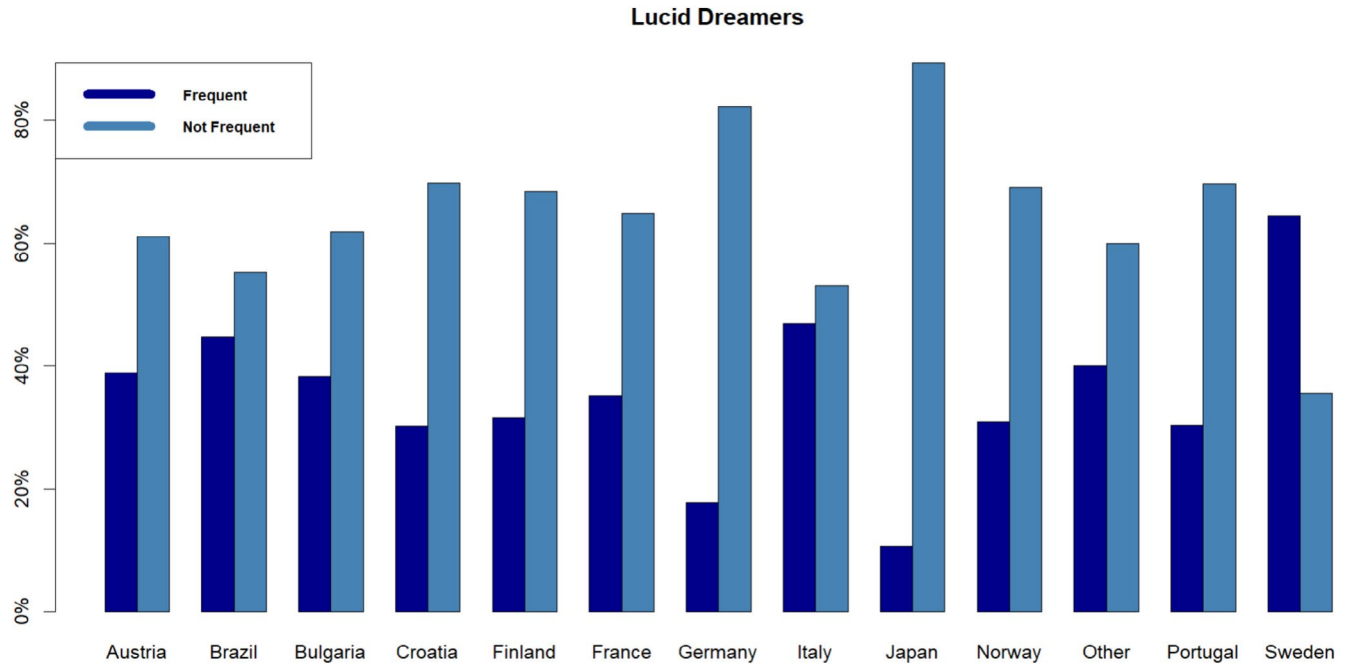

FIGURE 1 | Percentage of lucid dreamers (knowing to dream during their sleep) per country. Depicted is the percentage of participants experiencing dream awareness monthly for each country.

(62%) were between 30% and 40% of participants knowing at least once a month that they were dreaming during a dream, with Brazil (45%), Italy (47%), and Sweden (64%) showing higher frequencies, and Germany (18%) and Japan (11%) showing lower frequencies.

In the following models, only those participants without any missing values in any of the examined variables were included, which led to a sample of 8133, of which 1247 (15%) were classified as frequent LD + Ag.

In the final model, age, high risk of obstructive sleep apnea (OSA), sleep duration and depression symptoms were not included. Compared to the crude model, using only one variable to predict LD + Ag, the effect of gender was reverse; women had fewer LD + Ag episodes in the full model. This reversal is due to controlling for country; see Tables S1 and S2. Dream recall, nightmares, insomnia, dream enacting behaviours (DEB), singing, laughing and shouting during sleep, short and long COVID, and post-traumatic stress disorder (PTSD)-symptoms were positively associated with LD + Ag. The effect of anxiety symptoms was also reversed compared to the crude model and was negatively associated with LD + Ag. This is due to a combination of the inclusion of country, nightmares, PTSD, and insomnia, as is depicted in Table S3. Morningness–eveningness was still included in the final model but showed no significant relation to LD + Ag. Table 2 shows the Odds Ratios as well as the 95% confidence intervals for crude univariate models, as well as for the full model.

The model showed good performance metrics overall, with an area under the curve (AUC) of 0.811, and a pseudo McFadden R-squared of 0.196. Sensitivity and Specificity were used to optimise the best cutoff value, which then was set to 0.159. This

TABLE 2 | Frequencies, odds ratios and adjusted odds ratios for the LD + Ag models.

	Low LD + Ag frequency (*N*, %)	High LD + Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
Gender				
Men	2465 (35.8%)	367 (29.4%)		
Women	4421 (64.2%)	880 (70.6%)	1.34*** [1.17, 1.53]	0.75*** [0.64, 0.88]
Age group				
18–29	1464 (21.3%)	312 (25%)		
30–39	1157 (16.8%)	219 (17.6%)	0.89 [0.73, 1.07]	—
40–49	1303 (18.9%)	241 (19.3%)	0.87 [0.72, 1.04]	—
50–59	1292 (18.8%)	242 (19.4%)	0.88 [0.73, 1.06]	—
60–69	1000 (14.5%)	146 (11.7%)	0.69*** [0.55, 0.85]	—
70+	670 (9.7%)	87 (7%)	0.61*** [0.47, 0.78]	—
Dream recall				
Infrequent	4927 (71.6%)	421 (33.8%)		
Frequent	1959 (28.4%)	826 (66.2%)	4.93*** [4.34, 5.62]	3.49*** [3.03, 4.03]
Nightmares				
Infrequent	6231 (90.5%)	850 (68.2%)		
Frequent	655 (9.5%)	397 (31.8%)	4.44*** [3.85, 5.13]	2.79*** [2.33, 3.34]
Insomnia				
Not probable	4468 (64.9%)	588 (47.2%)		
Probable case	2418 (35.1%)	659 (52.8%)	2.07*** [1.83, 2.34]	1.23** [1.06, 1.44]
DEB				
Not probable	5604 (81.4%)	854 (68.5%)		
Probable case	1282 (18.6%)	393 (31.5%)	2.01*** [1.76, 2.3]	1.23* [1.04, 1.44]
OSA				
Low risk	6409 (93.1%)	1106 (88.7%)		
High risk	477 (6.9%)	141 (11.3%)	1.71*** [1.4, 2.08]	—
Sleep duration				
6–9 h	5560 (80.7%)	942 (75.5%)		
> 9 h	288 (4.2%)	95 (7.6%)	1.95*** [1.52, 2.47]	—
< 6 h	1038 (15.1%)	210 (16.8%)	1.19* [1.01, 1.4]	—

(Continues)

TABLE 2 | (Continued)

	Low LD + Ag frequency (*N*, %)	High LD + Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
Morningness–Eveningness				
Neither morning nor evening person	1833 (26.6%)	234 (18.8%)		
Definitively morning person	1206 (17.5%)	242 (19.4%)	1.57*** [1.29, 1.91]	1.24 [1, 1.54]
More morning than evening person	1440 (20.9%)	238 (19.1%)	1.29** [1.07, 1.57]	0.9 [0.72, 1.11]
More evening than morning person	1584 (23%)	332 (26.6%)	1.64*** [1.37, 1.97]	1.04 [0.85, 1.28]
Definitively evening person	823 (12%)	201 (16.1%)	1.91*** [1.56, 2.35]	1.09 [0.86, 1.37]
Singing, laughing and shouting during sleep				
Never or less frequently than once per month	6046 (87.8%)	906 (72.7%)		
Less than once per week	589 (8.6%)	189 (15.2%)	2.14*** [1.79, 2.55]	1.42*** [1.15, 1.74]
On 1–2 days per week	165 (2.4%)	91 (7.3%)	3.68*** [2.81, 4.79]	1.69*** [1.23, 2.29]
On 3–5 days per week	48 (0.7%)	32 (2.6%)	4.45*** [2.81, 6.96]	1.92* [1.13, 3.22]
Daily or almost daily	38 (0.6%)	29 (2.3%)	5.09*** [3.1, 8.28]	2.13** [1.2, 3.76]
Short/long COVID				
Control	6089 (88.4%)	885 (71%)		
Short COVID	200 (2.9%)	86 (6.9%)	2.96*** [2.27, 3.83]	2.44*** [1.81, 3.27]
Long COVID	597 (8.7%)	276 (22.1%)	3.18*** [2.71, 3.73]	1.83*** [1.51, 2.21]
PTSD				
Not probable	3990 (57.9%)	513 (41.1%)		
Probable case	2896 (42.1%)	734 (58.9%)	1.97*** [1.74, 2.23]	1.23** [1.05, 1.44]
Anxiety				
Not probable	2994 (43.5%)	362 (29%)		
Probable case	3892 (56.5%)	885 (71%)	1.88*** [1.65, 2.15]	0.84* [0.71, 1]
Depression				
Not probable	3402 (49.4%)	379 (30.4%)		
Probable case	3484 (50.6%)	868 (69.6%)	2.24*** [1.97, 2.55]	—
Country				
Austria	355 (5.2%)	82 (6.6%)		

(Continues)

TABLE 2 | (Continued)

	Low LD + Ag frequency (*N*, %)	High LD + Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
Brazil	124 (1.8%)	31 (2.5%)	1.08 [0.68, 1.70]	0.65 [0.39, 1.07]
Bulgaria	176 (2.6%)	45 (3.6%)	1.11 [0.73, 1.65]	1.03 [0.66, 1.60]
Croatia	364 (5.3%)	88 (7.1%)	1.05 [0.75, 1.46]	1.58* [1.10, 2.27]
Finland	766 (11.1%)	166 (13.3%)	0.94 [0.70, 1.26]	1.00 [0.73, 1.38]
France	225 (3.3%)	46 (3.7%)	0.89 [0.59, 1.31]	1.01 [0.65, 1.55]
Germany	410 (6%)	59 (4.7%)	0.62* [0.43, 0.89]	0.71 [0.47, 1.05]
Italy	543 (7.9%)	215 (17.2%)	1.71*** [1.29, 2.29]	1.74*** [1.27, 2.41]
Japan	2735 (39.7%)	156 (12.5%)	0.25*** [0.19, 0.33]	0.30*** [0.22, 0.42]
Norway	433 (6.3%)	97 (7.8%)	0.97 [0.70, 1.35]	0.93 [0.65, 1.32]
Other	20 (0.3%)	12 (1%)	2.60* [1.19, 5.46]	2.68* [1.16, 5.99]
Portugal	309 (4.5%)	81 (6.5%)	1.13 [0.81, 1.60]	1.37 [0.94, 1.99]
Sweden	426 (6.2%)	169 (13.6%)	1.72*** [1.28, 2.32]	2.05*** [1.48, 2.86]

Note: The table shows the frequencies as well as the odds ratios and adjusted odds ratios for LD + Ag. In the full model, gender, dream recall, nightmares, insomnia, DEB, morningness–eveningness, singing/laughing/shouting during sleep, short/long COVID, PTSD, anxiety and country were included. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

resulted in a sensitivity of 0.73, and a specificity of 0.73. This means that 73% of frequent LD + Ag were correctly classified and 73% of infrequent LD + Ag were correctly classified. Therefore, the accuracy was also equal to 0.73. However, due to the much larger class of infrequent LD + Ag, precision was rather low at only 0.33. So only a third of those classified as frequent LD + Ag were actually frequent LD + Ag.

To compare stability, the following significance levels were introduced (Sauerbrei and Schumacher 1992): inclusion in more than 50% of the models, related to a significance of less than 0.05; an inclusion rate of > 73% related to a significance of < 0.01.

Dream recall, nightmares, COVID-19, and country were included in 100% of the models. Singing, laughing, and shouting during sleep were included in 99% of the models; gender in 98%; DEB in 86%; PTSD in 83%; anxiety in 78%; morningness-eveningness in 76%; insomnia in 75%; sleep duration in 44%; depression in 41%; high risk of OSA in 35%; and age in 20%. The results therefore can be seen as stable.

In the final sample, 1089 (13%) were classified as frequent LD−Ag, meaning that they knew at least once a month that they were dreaming; but were not able to influence the dream content.

Gender, insomnia symptoms, PTSD, and depression were not included in the full model. LD−Ag was significantly positively associated with dream recall, nightmares and anxiety symptoms. Short sleep, definitive eveningness, daily or almost daily singing, laughing and shouting during sleep, and short COVID showed a negative association with LD−Ag. Participants in the age group 70 had significantly higher LD−Ag than the reference group of participants in the age group 18–29. DEB and high risk of OSA were still included in the final model but showed no significant connection to PLD. Table 3 shows the Odds Ratios as well as the 95% confidence intervals for the crude univariate model and the final model.

The model showed slightly lower performance metrics than the LD + Ag model, but still good performance overall, with an area under the curve (AUC) of 0.769, and a pseudo McFadden R-squared of 0.166. Sensitivity and Specificity were used to optimise the best cutoff value, which then was set to 0.137. This resulted in a sensitivity of 0.70, and a specificity of 0.70, thus an accuracy of 0.70. This means that 70% of frequent LD−Ag were

TABLE 3 | Frequencies, odds ratios and adjusted odds ratios for the LD−Ag models.

	Low LD−Ag frequency (*N*, %)	High LD−Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
Gender				
Men	2566 (36.4%)	266 (24.4%)		
Women	4478 (63.6%)	823 (75.6%)	1.77*** [1.53, 2.06]	—
Age group				
18–29	1518 (21.6%)	258 (23.7%)		
30–39	1194 (17%)	182 (16.7%)	0.90 [0.73, 1.1]	0.96 [0.77, 1.2]
40–49	1358 (19.3%)	186 (17.1%)	0.81* [0.66, 0.99]	0.96 [0.77, 1.21]
50–59	1337 (19%)	197 (18.1%)	0.87 [0.71, 1.06]	1.05 [0.83, 1.32]
60–69	988 (14%)	158 (14.5%)	0.94 [0.76, 1.16]	1.19 [0.92, 1.53]
70+	649 (9.2%)	108 (9.9%)	0.98 [0.77, 1.24]	1.50** [1.11, 2.01]
Dream recall				
Infrequent	4919 (69.8%)	429 (39.4%)		
Frequent	2125 (30.2%)	660 (60.6%)	3.56*** [3.12, 4.06]	2.65*** [2.29, 3.06]
Nightmares				
Infrequent	6258 (88.8%)	823 (75.6%)		
Frequent	786 (11.2%)	266 (24.4%)	2.57*** [2.20, 3.01]	1.85*** [1.54, 2.23]
Insomnia				
Not probable	4478 (63.6%)	578 (53.1%)		
Probable case	2566 (36.4%)	511 (46.9%)	1.54*** [1.36, 1.75]	—
DEB				
Not probable	5666 (80.4%)	792 (72.7%)		
Probable case	1378 (19.6%)	297 (27.3%)	1.54*** [1.33, 1.78]	1.17 [0.99, 1.39]
OSA				
Low risk	6530 (92.7%)	985 (90.4%)		
High risk	514 (7.3%)	104 (9.6%)	1.34** [1.07, 1.67]	1.20 [0.93, 1.53]
Sleep duration				
6–9 h	5608 (79.6%)	894 (82.1%)		
> 9 h	315 (4.5%)	68 (6.2%)	1.35* [1.02, 1.76]	0.89 [0.66, 1.18]

(Continues)

TABLE 3 | (Continued)

	Low LD−Ag frequency (*N*, %)	High LD−Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
< 6 h	1121 (15.9%)	127 (11.7%)	0.71*** [0.58, 0.86]	0.75* [0.61, 0.93]
Morningness–Eveningness				
Neither morning nor evening person	1844 (26.2%)	223 (20.5%)		
Definitively morning person	1269 (18%)	179 (16.4%)	1.17 [0.95, 1.44]	0.95 [0.76, 1.19]
More morning than evening person	1427 (20.3%)	251 (23.0%)	1.45*** [1.2, 1.77]	1.10 [0.89, 1.35]
More evening than morning person	1610 (22.9%)	306 (28.1%)	1.57*** [1.31, 1.89]	1.06 [0.86, 1.3]
Definitively evening person	894 (12.7%)	130 (11.9%)	1.20 [0.95, 1.51]	0.72** [0.55, 0.92]
Singing, laughing and shouting during sleep				
Never or less frequently than once per month	6079 (86.3%)	873 (80.2%)		
Less than once per week	646 (9.2%)	132 (12.1%)	1.42*** [1.16, 1.73]	1.07 [0.85, 1.34]
On 1–2 days per week	194 (2.8%)	62 (5.7%)	2.23*** [1.65, 2.97]	1.26 [0.9, 1.74]
On 3–5 days per week	64 (0.9%)	16 (1.5%)	1.74* [0.97, 2.95]	1.09 [0.59, 1.93]
Daily or almost daily	61 (0.9%)	6 (0.6%)	0.68 [0.26, 1.46]	0.32* [0.12, 0.72]
Short/long COVID				
Control	6084 (86.4%)	890 (81.7%)		
Short COVID	253 (3.6%)	33 (3%)	0.89 [0.61, 1.27]	0.61* [0.41, 0.9]
Long COVID	707 (10%)	166 (15.2%)	1.61*** [1.33, 1.92]	0.83 [0.67, 1.02]
PTSD				
Not probable	3987 (56.6%)	516 (47.4%)		
Probable case	3057 (43.4%)	573 (52.6%)	1.45*** [1.27, 1.65]	—
Anxiety				
Not probable	3026 (43%)	330 (30.3%)		
Probable case	4018 (57%)	759 (69.7%)	1.73*** [1.51, 1.99]	1.26** [1.07, 1.49]
Depression				
Not probable	3402 (48.3%)	379 (34.8%)		
Probable case	3642 (51.7%)	710 (65.2%)	1.75*** [1.53, 2]	—

(Continues)

TABLE 3 | (Continued)

	Low LD−Ag frequency (*N*, %)	High LD−Ag frequency (*N*, %)	Crude model odds ratio and 95% CI	Adjusted OR and 95% CI
Country				
Austria	346 (4.9%)	91 (8.4%)		
Brazil	118 (1.7%)	37 (3.4%)	1.19 [0.76, 1.83]	1.07 [0.67, 1.69]
Bulgaria	183 (2.6%)	38 (3.5%)	0.79 [0.51, 1.19]	1.04 [0.66, 1.60]
Croatia	403 (5.7%)	49 (4.5%)	0.46*** [0.32, 0.67]	0.62 [0.42, 0.92]
Finland	796 (11.3%)	136 (12.5%)	0.65** [0.48, 0.87]	0.67 [0.50, 0.92]
France	218 (3.1%)	53 (4.9%)	0.92 [0.63, 1.35]	1.10 [0.73, 1.62]
Germany	440 (6.2%)	29 (2.7%)	0.25*** [0.16, 0.38]	0.28 [0.18, 0.45]
Italy	598 (8.5%)	160 (14.7%)	1.02 [0.76, 1.36]	1.21 [0.89, 1.67]
Japan	2733 (38.8%)	158 (14.5%)	0.22*** [0.17, 0.29]	0.26 [0.19, 0.35]
Norway	453 (6.4%)	77 (7.1%)	0.65* [0.46, 0.90]	0.72 [0.51, 1.02]
Other	29 (0.4%)	3 (0.3%)	0.39 [0.09, 1.14]	0.43 [0.10, 1.27]
Portugal	345 (4.9%)	45 (4.1%)	0.50*** [0.33, 0.73]	0.56 [0.37, 0.83]
Sweden	382 (5.4%)	213 (19.6%)	2.12*** [1.60, 2.83]	2.38 [1.76, 3.25]

Note: The table shows the frequencies as well as the odds ratios and adjusted odds ratios for LD−Ag. In the final model, age, dream recall, nightmares, DEB, OSA, sleep duration, morningness–eveningness, signing/laughing/shouting during sleep, short/long COVID, and anxiety were included. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

correctly classified and 70% of infrequent LD−Ag were correctly classified. Again, due to the much larger class of infrequent LD−Ag, precision was very low at only 0.27.

Dream recall, nightmares and country were included in 100% of the models. Anxiety was included in 96%; morningness-eveningness in 93%; COVID-19 in 88%; singing, laughing and shouting during sleep in 87%; sleep duration in 84%; age in 79%; DEB in 62%; high risk of OSA in 53%; insomnia in 39%; gender in 30%; PTSD in 18%; and depression in 16% of the models. The variable selection is less stable, especially variables like high risk of OSA and DEB, which did not reach significance in the final model and were often not selected.

4 | Discussion

We found that during the pandemic almost a third of the participants had at least monthly a dream in which they knew that they were dreaming, and about half of them could also influence the dream on a monthly basis. Less than 20% of people were aware they were dreaming on a weekly basis; of those, only around half were able to influence the dream. This striking difference is in line with previous findings, which state that agency in dreams is rather rare and not necessarily the norm (Aviram and Soffer-Dudek 2018; Mota-Rolim et al. 2013). Further, almost half of the participants never or less than once per year knew that they were dreaming during a dream, and almost two-thirds never or less than once per year could influence the dream. These frequencies are comparable to a previous meta-analysis spanning studies from 1966 to 2016 (Saunders et al. 2016).

We observed that although the pandemic changed frequencies of both LD−Ag and LD+Ag, these changes were quite small and negligible. Since the pandemic had an effect on general dream recall (Fränkl et al. 2021), as well as nightmares (Ableidinger et al. 2022; Scarpelli, Nadorff, et al. 2022), it is quite surprising that LD−Ag and LD+Ag frequencies were hardly affected by this. Even more so, as dream and nightmare recall frequencies are intrinsically related to LD recall frequency (Biehl 2022; Hess

et al. 2017; Schredl et al. 2022). Since LD−Ag and LD + Ag are infrequent phenomena, it is possible that most participants did not accurately remember how often they experienced LD−Ag and LD + Ag before the pandemic and used their current frequencies as a reference. In one study, increased LD was found during a lockdown compared to the week after the lockdown (Scarpelli, Gorgoni, et al. 2022). LD frequencies might therefore fluctuate due to external events, and such effects might not be detected by a survey with a longer data gathering phase such as this one.

COVID-19 had a significant influence on LD + Ag, as both short- and long-COVID were positively associated with frequent LD + Ag, even when controlling for other important variables. For LD−Ag, on the other hand, results were different, since after controlling for other important variables, short-COVID was negatively associated with frequent LD−Ag. COVID-19 and long COVID have been found to influence sleep, dreams and nightmares (Bourmistrova et al. 2022; Scarpelli et al. 2023; Scarpelli, Nadorff, et al. 2022). Therefore, it is not surprising that it also has an influence on LD. However, it seems somewhat counterintuitive that short COVID is negatively associated with LD−Ag. As there are only 33 participants in the short COVID group who were classified as frequent LD−Ag, this unusual finding might reflect a sampling error.

As was found in previous studies, both LD−Ag and LD + Ag were positively related to dream recall (Biehl 2022; Erlacher et al. 2008; Hess et al. 2017; Mota-Rolim et al. 2013; Schredl et al. 2022; Wolpin et al. 1992). Additionally, in accordance with prior studies, both LD−Ag and LD + Ag were positively related to nightmares (Biehl 2022; Hess et al. 2017; Scarpelli et al. 2021; Schadow et al. 2018; Schredl et al. 2022). In one study, this association did not survive when controlling for dream recall (Erlacher et al. 2008); but this was not the case in the present work.

We found that female gender was negatively related to LD + Ag, but not to LD−Ag. This is in accordance with a previous study, which found that agency in LD was higher in men (Yokusoglu et al. 2017). Most studies have not found a relationship between gender and LD (Hess et al. 2017; Zink and Pietrowsky 2013). However, some works have shown that men do experience LD more often (Schredl et al. 2022). Conversely, one study found that LD recall was significantly higher in women (Schredl and Erlacher 2011). In general, women tend to remember dreams more often (Schredl and Reinhard 2008) and have nightmares more often (Schredl and Reinhard 2011), making the result all the more surprising.

LD + Ag was also significantly predicted by insomnia. This is in accordance with previous findings, where LD was connected to poor sleep quality (Aviram and Soffer-Dudek 2018). While in some studies, LD is not connected to poor sleep quality, when controlling for nightmares (Schadow et al. 2018), the relationship is still significant in this work. Surprisingly, LD−Ag did not show any association with insomnia.

We further observed that LD + Ag was positively related to DEB. The connection between dream enactment and LD has thus far been hardly mentioned in current literature. To our knowledge, there are only two previous studies showing a direct association between DEB and LD (Kelly et al. 2022; Klofat and Steingen 2023). A recent review suggests a link between sleep-related dissociative states, with LD being an example of a physiological state of consciousness and REM sleep behaviour disorder of a pathological one (Sodré et al. 2023). LD + Ag was further related to signing, laughing, and shouting during sleep. With a higher frequency of sleep vocalisation, the odds ratio for frequent LD + Ag also increased.

While we initially expected that awareness combined with agency had positive associations with mental health, we found a relation of LD + Ag to PTSD symptoms, even when controlling for nightmares. At the same time, LD + Ag was negatively associated with anxiety, which would be in line with our expectations. However, this association only showed up when controlling for other variables, like nightmares, PTSD symptoms and insomnia. It is known that there is some interconnection between those variables as well as anxiety (Richards et al. 2020). In PTSD, nightmares and sleep disturbances are diagnostic criteria, and associations with DEB have been found as well. PTSD and anxiety also often coincide. This might hint at a complex relation between these variables as well as LD.

Traumatised and negatively affected individuals seem to experience LD + Ag more frequently, as can be seen by the positive association to PTSD symptoms, insomnia, nightmares, DEB and sleep vocalisation, and short- and long-COVID. However, LD + Ag is also associated with lower anxiety. LD, especially with agency, might act as a self-healing mechanism, which might come into play after traumatization (Tholey 1988). One hint for this might be the overall higher LD prevalence in PTSD sufferers (Miller et al. 2021). However, in most studies, high awareness and low agency were found in PTSD sufferers. One possible explanation is that LD without agency (LD−Ag) is a form of incomplete LD, or a 'midway state' (Wong and Yu 2022), where this healing mechanism is already activated but not completely, and dreamers get stuck in dreams with high awareness but low agency. PTSD sufferers who have higher agency might experience fewer PTSD symptoms, or at least fewer nightmares, and therefore might not appear in studies directed at lucid nightmares. This may indicate further potential of LD not only for nightmare treatment, but also for further increasing overall well-being, personal development and calming anxiety and depressive symptoms. Effectively handling nightmares is crucial given the connection to suicidal ideation (Bolstad et al. 2024). Indeed, LD therapy is a promising approach to treat nightmares (De Macêdo et al. 2019). Preliminary evidence also shows LD to be effective for the treatment of mental health issues (Sackwild and Stumbrys 2021). 40% of lucid dreamers indicate they use LD for healing (Stumbrys and Erlacher 2016) and in a sample of 386 lucid dreamers, 90% stated that LD had a positive effect on either their mental or physical health (Erlacher et al. 2021).

Whatever the case, these results emphasise that in research it is critical to distinguish more clearly between dreams with the ability to influence their content and dreams without. Another special form of dreaming often mentioned in connection to these is 'pre-lucid' dreams, defined as dreams in which dreamers ask themselves if they are dreaming but cannot make the conclusion

that they are indeed dreaming (Green 1968). This suggests that there are several steps from normal dreams to lucid dreams with agency, with pre-lucid dreams and lucid dreams without agency in between. This begs the question of what differences arise from these steps. We argue that the difference that emerges with the ability to volitionally act in a dream is of more significance than the difference in awareness of dreaming and is important to be reflected in research. This is underlined by the qualitative difference that arises with this ability, and the significant difference in the effect of such dreams on mental health (Aviram and Soffer-Dudek 2018). The findings of this study highlight that LD−Ag and LD + Ag should not be mixed up and treated as equal.

5 | Strengths and Limitations

One limitation of this study was that due to how the groups of frequent LD−Ag and LD + Ag were defined and compared to the general population, the other group was always part of the comparison group. As mentioned, LD−Ag might be a step in-between normal dreams or nightmares and LD + Ag, so by including these in the comparison group, some associations might have been altered, as there are probably some closer relations between frequent LD−Ag and frequent LD + Ag than between them and the remaining general population. On the other hand, these groups were much smaller than the remaining sample, so they should not carry as much weight in the models. Further, the differences between these groups might be more pronounced by including them in the model.

Another shortcoming is that participants who experience frequent LD + Ag might also experience frequent LD−Ag, meaning they could experience both a lot of dreams in which they can volitionally act and dreams in which they cannot but are aware that they are dreaming. The possibility of this cannot be excluded but has implications for the comparison between these two groups. It might also be that in dreamers who frequently experience awareness of dreaming and agency in their dreams, LD−Ag are not as negative as in other groups. The frequency of LD−Ag in these dreamers should be studied in future research. There also might be differences in the LD−Ag group, as participants in this group might also experience regular LD + Ag but less often than once a month. Differences in this group should be explored in future research.

The results are further limited due to the data being solely generated through self-reports, producing possible recall bias, especially in rare phenomena like LD−Ag and LD + Ag. As the data is cross-sectional, causation cannot be inferred. For example, anxiety and insomnia are used to predict LD−Ag and LD + Ag, but it is also reasonable to assume that LD−Ag and LD + Ag can predict anxiety and insomnia. Finally, a strength of this study is the large sample size and the sample spanning various different countries on four continents. Further, as this study was not labelled as an LD study, self-selecting biases in this direction can be ruled out. However, the sample is still a convenience sample, and participants interested in sleep and dreams could have been more likely to participate. The resulting sample might not be necessarily representative of the general population.

6 | Conclusions

Awareness of dreaming and being able to influence the dreams are both rare phenomena. While some increase in LD−Ag and LD + Ag due to the pandemic was found, the difference was small. However, COVID-19 and long COVID were significantly associated with LD + Ag.

As the ability to influence a dream is even rarer than awareness of dreaming, often researchers use only awareness as a defining criterion for LD. In this study, we have found preliminary evidence that there are differences between lucid dreams with agency and lucid dreams without, and that these are associated with different factors. This has critical implications, as it might resolve mixed results in terms of the connection of LD, sleep problems and mental health. We found that anxiety symptoms were negatively associated to LD + Ag and positively associated with LD−Ag. However, LD + Ag was also positively associated with insomnia, PTSD, DEB, sleep vocalisation and short and long COVID.

The association between LD−Ag and LD + Ag to sleep problems and mental health should be further examined; the difference should be further studied.

Author Contributions

Severin Ableidinger: writing – original draft, methodology, formal analysis. **Luigi De Gennaro:** conceptualization, writing – review and editing, methodology, investigation. **Sergio Mota-Rolim:** conceptualization, writing – review and editing, investigation. **Serena Scarpelli:** conceptualization, investigation, writing – review and editing. **Courtney J. Bolstad:** conceptualization, writing – review and editing, investigation. **Bjørn Bjorvatn:** conceptualization, investigation, writing – review and editing. **Colin A. Espie:** conceptualization, investigation, writing – review and editing. **Yves Dauvilliers:** conceptualization, investigation, writing – review and editing. **Maria Korman:** conceptualization, investigation, writing – review and editing. **Anne-Marie Landtblom:** conceptualization, investigation, writing – review and editing. **Giuseppe Plazzi:** conceptualization, investigation, writing – review and editing. **Kentaro Matsui:** conceptualization, investigation, writing – review and editing. **Juliana Yordanova:** conceptualization, writing – review and editing, investigation. **Adrijana Koscec Bjelajac:** conceptualization, investigation, writing – review and editing. **Catia Reis:** conceptualization, investigation, writing – review and editing. **Frances Chung:** conceptualization, investigation, writing – review and editing. **Ilona Merikanto:** conceptualization, investigation, writing – review and editing, data curation. **Yun K. Wing:** conceptualization, investigation, writing – review and editing. **Markku Partinen:** conceptualization, investigation, writing – review and editing, data curation, methodology. **Tainá Macêdo:** conceptualization, investigation, writing – review and editing. **Michael R. Nadorff:** conceptualization, investigation, writing – review and editing. **Brigitte Holzinger:** conceptualization, investigation, writing – review and editing, methodology, supervision.

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N/A

Conflicts of Interest

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.