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Sleep in Psychotic Disorders: Results From Nationwide SUPER Finland Study

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Objective: **Characterizing sleep in patients with schizophrenia, schizoaffective disorder, bipolar disorder, and psychotic depression.** ***Methods:*** **This cross-sectional questionnaire study is based on the SUPER study sample, which is part of the Stanley Global Neuropsychiatric Genomics Initiative. The study is a multicentre, nationwide Finnish study consisting of patients (*N* = 8 623) both in primary and specialized health care. The main measurements were sleep duration, difficulties initiating sleep, early morning awakenings, and fatigue. These results were compared with a nationally representative sample of the Finnish population from the Health 2000 survey (*N* = 7 167) with frequency and logistic regression analyses.** ***Results:*** **Patients had more sleep problems compared with the general population, especially young and middle-aged patients (Difficulties initiating sleep in young patients odds ratio = 12.3, 95% CI 9.8–15.4). Long sleep duration was the most deviating property of the sleep characteristics, being particularly common among young patients with schizophrenia (odds ratio = 27.9, 95% CI 22.1–35.2, 47.4% vs 3.3% prevalence). All sleep problems were associated with worse subjective health. We also conducted a latent class analysis, resulting in a cluster relatively free of sleep problems (58% of patients), an insomnia symptom cluster (26%), and a hypersomnia symptom cluster (15%).** ***Conclusions:*** **In our sample, patients with psychotic disorders have more sleep problems—especially long sleep duration but also insomnia symptoms—compared with the general population. The patients can in a latent class analysis of their sleep symptoms be divided into groups with differing sleep profiles.**

Key words: sleep problems/insomnia/hypersomnia/cluster analysis

Introduction

Disturbed sleep is common in patients with psychotic disorders, and the relationship between sleep and psychiatric disorders is seen as bidirectional.[1] Despite increasing knowledge on sleep problems in patients with psychotic disorders, studies with large samples that are able to compare the sleep characteristics between different diagnostic groups and the general population are lacking.[2]

In previous studies, patients with schizophrenia receiving antipsychotic medication have had an increased frequency of both insomnia (16–30%) and hypersomnia symptoms (24–31%).[3] The insomnia symptoms have included difficulty initiating sleep (DIS), early morning awakenings (EMAs), and reduced sleep efficiency.[4,5] Hypersomnia or excessive sleepiness in patients with psychotic disorders have traditionally been linked with the antipsychotic medications,[6] but there is also new research suggesting other possible contributors such as genetics,

low activity, and other sleep disorders.[7,8] Sleep problems in patients with schizophrenia have been linked to more positive symptoms, higher suicidality, and lower quality of life.[9,10]

In bipolar disorder, different types of sleep problems—disturbed sleep and a distorted sleep–wake cycle—emerge in different phases of the disorder. Insomnia symptoms are manifested particularly in the manic but also in the euthymic phase, including short sleep duration (short SD), EMAs, and DIS.[11,12] In the depressive phase the results have been more heterogeneous, with both insomnia and hypersomnia symptoms found in self-report studies.[11]

Studies investigating the sleep of patients with schizoaffective disorder and psychotic depression have generally been of small sample size. Compared to patients with schizophrenia, patients with schizoaffective disorder seem to have more insomnia symptoms, as do patients with psychotic depression compared to patients with non-psychotic major depression.[13,14]

There is a gap in the current knowledge of how the prevalence of different types of sleep problems is related to age, gender, and diagnosis among patients with psychotic disorders. However, in the general population, age and gender effects have been apparent. With increasing age, people report increased DIS, EMAs and short SD.[15] Women experience more sleep problems but longer sleep duration in self-report studies than men.[16]

Large studies on disturbed sleep in psychotic disorders including more than one diagnostic group are lacking, making a comparison between diagnostic groups challenging. The main goal of the present study was to characterize self-reported sleep problems in patients with schizophrenia, schizoaffective disorder, bipolar disorder, and psychotic depression. We also examined how age and gender were related to the prevalence of sleep problems, and the association between sleep characteristics and subjective health. Our hypotheses were that all sleep problems included in our study are more common in individuals with psychotic disorders, that these problems are associated with a worse subjective health and that these patients can in a latent class analysis be split into groups based on their sleep symptoms.

Methods

Study Samples

This study is part of the SUPER research project, which examines psychotic disorders. The SUPER project is part of the international Stanley Global Neuropsychiatric Genomics Initiative. In Finland, the Institute for Molecular Medicine Finland (FIMM) is in charge of the research project. The project has been done in cooperation with the Finnish Institute for Health and Welfare (THL) and all hospital districts in Finland.

SUPER study. Patients with schizophrenia spectrum disorders (ICD-10 codes: F20–F29), bipolar disorder, and psychotic depression (ICD-10 codes: F30.1, F30.2, F31, F32.3, and F33.3) were invited to participate through psychiatric in- and outpatient units, primary care, housing units, and advertisements in local newspapers from the whole of mainland Finland. In the present study only patients with schizophrenia, schizoaffective disorder, bipolar disorder, and psychotic depression are included. The diagnoses were retrieved from the Finnish Care Register for Health Care (HILMO).

Where participants had multiple diagnoses, the diagnoses were considered in the following order of preference: 1. Schizophrenia, 2. Schizoaffective disorder, 3. Bipolar disorder, 4. Psychotic depression, 5. Delusional disorder, 6. Other psychoses. No minors or legally incapacitated persons participated in the study. The study has been approved by the Ethics Committee of the Hospital District of Helsinki and Uusimaa and by all participating healthcare organizations.

The patients were informed about the study by the treating unit, either during a normal doctor's appointment, a hospital stay, or at a nursing home. Research nurses/staff provided the patient with oral and written information on the study and acquired written informed consent, after which the study protocol began.

The total sample size was 10 470 patients. After excluding patients with an unknown diagnosis or diagnosis other than our four diagnostic groups, and patients with an unknown age or older than 80 years, there were 8795 patients left. Finally, patients who had not answered any sleep question were excluded, resulting in 8623 patients remaining. For the study sample flow chart, see Supplementary Figure 2.

Health 2000 study. The Health 2000 survey was a nationally representative, two-stage cluster sample of the Finnish population, comprising 9922 persons. 7167 of the study participants were 18–80 years old and answered at least one sleep-related question. The study was led by the National Public Health Institute of Finland (KTL), a precursor of THL. The fieldwork was conducted between September 2000 and June 2001, and consisted of a home interview and a health examination at the local health center, or a condensed interview and health examination of nonrespondents at home. Questionnaires were also used to evaluate symptoms, lifestyle, and exposure related to different health problems. The questionnaires contained largely the same questions about sleep as the SUPER study (see Phenotypes). The Health 2000 survey was approved by the National Public Health Institute's ethical committee and the Coordinating Ethics Committee at the Hospital District of Helsinki and Uusimaa. Written informed consent was received from each participant.

In the Psychosis in Finland study, persons aged 30 years or more in the Health 2000 sample were screened for psychotic disorders using self-reported symptoms and diagnoses, and information from the health examination and Finnish healthcare registers. The mental health

diagnoses were made based on an interview (the research version of the Structured Clinical Interview for DSM-IV, SCID-I) and case records. Diagnoses were made for 692 persons, of which 46 received a diagnosis of schizophrenia, 18 schizoaffective disorder, 12 bipolar disorder, and 20 psychotic depression diagnosis, and had answered to the sleep questions.

Demographics of the SUPER Sleep and Health 2000 Cohorts

Patients with schizophrenia were the largest diagnostic group in the SUPER sample (demographics in table 1); 60.2% were men. In the other diagnostic groups, there was a majority of women. The mean time since onset being 8.7 years in 18- to 40-year-old patients, 20.5 years in 41- to 60-year-old patients, and 30.2 years in 61- to 80-year-old patients.

Phenotypes

The sleep symptoms were assessed as part of a questionnaire. The full questions can be seen in table 2. Regarding the sleep questions, total sleep duration (TSD),[17] difficulties initiating sleep (DIS),[18] early morning awakenings (EMAs),[18] and fatigue (FAT)[17] were asked in both studies. Subjective sleep quality (SQ)[19] was only asked in the SUPER study. Subjective health and depressive mood[20] were also only used from the SUPER study.

Covariates

The covariates were age, gender, diagnosis, depressive mood, and working status.

Depressive mood was retrieved from questionnaire: "How much of the time recently have you felt downhearted and blue?". The possible answers were "All of the time", "most of the time", "a good bit of the time", "some of the time", "a little of the time", and "none of the time". A depressive mood was defined as feeling downhearted and blue most or all of the time.

Working status was retrieved from the interview: "Which of the following alternatives best describes your main occupation during the last year, that is, the occupation that you use most time doing? "full-time employment", "part-time employment", "student", "rehabilitation subsidy/ long-term sickness allowance", "disability pension", "old-age pension", "unemployed or laid off", "caring for their own household or family members", "military or civil service", "other, describe". To be categorized as working the patient must have answered full-time employment, part-time employment, student, or military or civil service.

Statistical Analysis

To compare the prevalence of the sleep problems in psychotic disorders and in the general population, we used logistic regression with diagnostic group, age and gender as independent variables.

First we included age, gender, and diagnostic group interactions in the models. Next, we dropped the non-significant interactions. Most interactions were related to age. Therefore, we split the sample into three age groups (young 18–40, middle-aged 41–60, elderly 61–80 years old) and ran logistic regression models with gender and diagnosis as covariates within the age groups. The same age group split was used when analyzing the frequency of sleep problems.

To investigate the effect of employment, we analyzed the frequency of sleep problems, while splitting the sample into working and non-working patients. We also repeated the logistic regression analyses but now included working status as a covariate. We also rerun the logistic regression analyses excluding patients with more than one of our four main diagnoses. The exclusion did not change the results and therefore patients with multiple diagnoses are included in the statistical analyses.

We used latent class analysis (LCA) to group patients based on their sleep symptoms. The latent class indicators were long SD, EMAs, DIS, and FAT. The optimal number

Table 1. Demographics of the Study

	SZ		SZ-A		BD		Ps-DEP	
Proportion of sample, *n* (%)	5597	(64.9)	930	(10.8)	1586	(18.4)	510	(5.9)
Gender (Men) *n* (%)	3218	(57.5)	351	(37.7)	599	(37.8)	191	(37.5)
18–40 years *n* (%)	1804	(32.2)	410	(44.1)	652	(41.1)	213	(41.8)
41–60 years *n* (%)	2594	(46.3)	410	(44.1)	674	(42.5)	181	(35.6)
61–80 years *n* (%)	1199	(21.4)	110	(11.8)	260	(16.4)	115	(22.6)
Age, M (SD)	47.8	(13.9)	43.5	(13.6)	45.0	(14.3)	45.1	(17.0)
Years since onset, M (SD)	21.3	(12.7)	15.7	(9.7)	11.4	(8.1)	9.8	(8.2)
Low level of education *n* (%)	2268	(41.5)	223	(24.8)	319	(21.3)	143	(29.2)
Intermediate level of education *n* (%)	544	(50.9)	544	(60.5)	903	(60.3)	290	(59.3)
High level of education *n* (%)	418	(7.6)	132	(14.7)	276	(18.4)	56	(11.5)
Married/cohabiting *n* (%)	728	(13.0)	247	(26.6)	612	(38.6)	152	(29.9)

Note: SZ, Schizophrenia; SZ-A, Schizoaffective disorder; BD, Bipolar disorder; Ps-DEP, Psychotic depression.

Table 2. Full Questions Used in the Study

Questions	Answers	Categorized as
Total sleep duration, TSD: How long do you usually sleep at night? How long do you usually sleep during the daytime?	The patient wrote the number of hours and minutes for both questions freely. The night and day sleep were summed into TSD and compared with the Health 2000 study question "How many hours do you sleep per day?"	Responses that had unreasonable answers(N = 21)to the sleep duration question (TSD < 2 hours or≥ 18 hours) were excluded. Long SD was defined as sleeping 10 hours or more and short SD as sleeping 6 hours or less.
Difficulty initiating sleep, DIS: Do you have difficulties falling asleep without sleep medication?[2]	Not at all, sometimes, often and nearly always.	DIS was defined as "often" and "nearly always".
Early morning awakenings, EMAs: Do you wake up during sleep at night or very early in the morning?	Not at all, sometimes, often and nearly always.	EMAs were defined as "often" and "nearly always".
Fatigue, FAT: Do you consider yourself to be fatigued more often than other people of the same age during the daytime?	Yes, nearly always; yes, often (at least weekly); no; I cannot say.	FAT was defined as"Yes, nearly always" and "yes, often".
Sleep quality, SQ: How well have you slept during the last month?	Well, rather well, neither well nor poorly, rather poorly, poorly.	Poor SQ was defined as having slept "rather poorly" or "poorly".
Self-rated health: Assess your own current state of health by entering the number that best corresponds to your current state of health.	Numeric scale from 0 to 10.	-

of classes was determined by the Bayesian information criterion and bootstrap likelihood ratio test, which both gave similar results.

To analyze how sleep problems are associated with the patients' subjective health we conducted univariate general linear models, with gender, age, and diagnosis as covariates. We did a post hoc analysis with depressive mood as a covariate as well. We used Mplus 7.3 for the LCA. The other analyses were conducted with SPSS Statistics 25.

Results

Sleep Problems

Generally, the psychiatric patients had more sleep problems than the general population, but with increasing age, the difference diminished because the problems stayed the same or decreased among the psychiatric patients and increased among the general population (figure 1). This was confirmed by the age*diagnosis interaction in the logistic regression models for every sleep question (Wald>30, df 8, P < .001, table 3). Hence, the results are presented in age-split groups (18–40, 41–60, 61–80 years).

Sleep Duration

Long SD was strongly over-represented in all diagnostic groups in all age groups (odds ratio [OR]>2.7, P < .001, figure 1A and table 3). Young patients with schizophrenia most frequently experienced long SD (47.4%, OR 27.9, 95% confidence interval [CI] 22.1–35.2, P < .001). Short SD was more common among patients with bipolar disorder and psychotic depression compared with the patients with schizophrenia and schizoaffective disorder, but only as common as in the general population (Supplementary material, table 1, figure 1).

Difficulty Initiating Sleep Without Sleep Medication

DIS was more prevalent among all diagnostic groups in all age groups than in the general population (figure 1B, table 3). DIS was most frequent in the youngest age group and among patients with bipolar disorder and psychotic depression. Consequently, young patients with psychotic depression (45.3%, OR = 24.8, 95% CI 17.6–35.0, P < .001) and bipolar disorder (41.6%, OR = 21.3, 95% CI 16.4–29.7, P < .001) had most DIS.

Besides the age*diagnosis interaction, DIS had an age*gender interaction (Wald 6.60, df 2, P = .037). With increasing age, the difference between men and women increased: in young patients, there were no significant gender differences, while elderly women patients had more DIS than men.

Early Morning Awakenings

The frequency of EMAs was increased in all diagnostic groups compared with the general population in young and middle-aged patients, but not in elderly patients. EMAs were especially common in patients with psychotic depression, bipolar disorder, and schizoaffective disorder (figure 1C, table 3).

EMAs had the same interactions as DIS: age*diagnosis and age*gender (Wald 9.28, df 2, P = .010), indicating the same age-related differences described earlier.

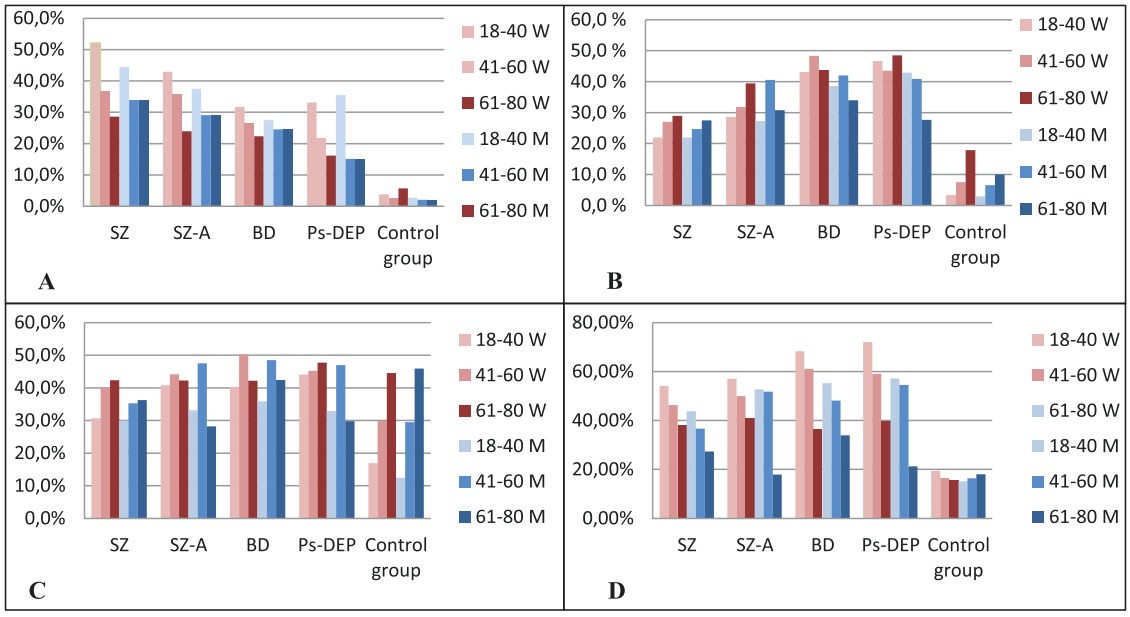

Fig. 1. Prevalence of sleep problems in the diagnostic groups and controls (Health 2000). *Note*: SZ, Schizophrenia; SZ-A, Schizoaffective disorder; BD, Bipolar disorder; Ps-DEP, Psychotic depression; M, Men; W, Women.

Table 3. Results From Logistic Regression Analysis for Long Sleep Duration (>9 hours), Difficulties Initiating Sleep, Early Morning Awakenings, and Fatigue

	18–40 years			41–60 years			61–80 years		
	OR	**CI**	***P***	**OR**	**CI**	***P***	**OR**	**CI**	***P***
Long sleep duration									
Gender[a]	0.77	0.67–0.89	<.001	0.86	0.75–0.98	0.025	0.81	0.66–1.00	0.046
Diagnosis[b]			<.001			<.001			<.001
SZ	27.9	22.13–35.17	<.001	23.42	18.00–30.46	<.001	5.82	4.51–7.51	<.001
SZ-A	20.09	15.05–26.81	<.001	21.04	15.21–29.09	<.001	3.29	1.92–5.66	<.001
BD	12.45	9.51–16.30	<.001	14.57	10.75–19.75	<.001	3.67	2.51–5.36	<.001
Ps-DEP	14.84	10.41–21.14	<.001	10.03	6.42–15.67	<.001	2.71	1.55–4.74	<.001
Difficulties initiating sleep									
Gender	0.93	0.79–1.08	0.319	0.9	0.79–1.02	0.106	0.7	0.59–0.84	<.001
Diagnosis			<.001			<.001			<.001
SZ	8.61	6.77–10.96	<.001	4.55	3.84–5.40	<.001	2.39	1.97–2.91	<.001
SZ-A	11.73	8.67–15.88	<.001	6.9	5.38–8.87	<.001	3.28	2.17–4.98	<.001
BD	21.29	16.35–27.72	<.001	10.97	8.89–13.54	<.001	3.87	2.90–5.17	<.001
Ps-DEP	24.82	17.59–35.01	<.001	9.66	6.95–13.43	<.001	3.91	2.62–5.85	<.001
Early morning awakenings									
Gender	0.8	0.71–0.91	<.001	0.92	0.83–1.01	0.094	0.89	0.77–1.03	0.11
Diagnosis		<.001				<.001			0.038
SZ	2.58	2.23–2.98	<.001	1.42	1.27–1.60	<.001	0.79	0.68–0.92	0.003
SZ-A	3.43	2.74–4.29	<.001	1.98	1.58–2.41	<.001	0.72	0.48–1.07	0.104
BD	3.54	2.94–4.28	<.001	2.31	1.95–2.75	<.001	0.89	0.68–1.16	0.396
Ps-DEP	3.75	2.80–5.03	<.001	1.99	1.47–2.69	<.001	0.82	0.56–1.21	0.323
Fatigue									
Gender	0.68	0.61–0.77	<.0.01	0.77	0.69–0.86	<.001	0.77	0.65–0.91	0.002
Diagnosis			<.001			<.001			<.001
SZ	4.63	4.05–5.30	<.001	3.61	3.17–4.10	<.001	2.46	2.05–2.97	<.001
SZ-A	5.81	4.67–7.22	<.001	5.06	4.07–6.30	<.001	2.39	1.57–3.64	<.001
BD	8.09	6.71–9.76	<.001	6.36	5.30–7.64	<.001	2.75	2.05–3.67	<.001
Ps-DEP	9.25	6.84–12.51	<.001	6.71	4.91–9.16	<.001	2.46	2.05–2.97	<.001

Note: SZ, Schizophrenia; SZ-A, Schizoaffective disorder; BD, Bipolar disorder; Ps-DEP, Psychotic depression
[a]Reference group: women
[b]Reference group: the control group (Health 2000)

Fatigue

FAT was more common in all diagnostic groups in all age groups compared with the general population (OR>2.3, $P < .001$, figure 1D and table 3). FAT had a higher prevalence among women and young patients. FAT was most frequent among young patients with psychotic depression (66.8%, OR = 9.3, 95% CI 6.8–12.5, $P < .001$) and bipolar disorder (63.7%, OR = 8.1, 95% CI 6.7–9.8, $P < .001$).

For FAT, the same interactions as in DIS and EMAs were significant: age*diagnosis and age*gender (Wald 8.4, df 2, $P = .015$). In addition, a gender*diagnosis (Wald 14.4, df 4, $P = .006$) interaction was significant, indicating that gender differences were larger among the psychiatric patients than in the general population (women patients experienced more FAT than men).

Employment and Sleep Problems

Sleep problems were more prevalent among people who were not employed, but the relative differences were larger in the general population than inside the diagnostic groups. For example, long SD among young patients with schizophrenia had a prevalence of 49.7% among patients not working, compared with 38.5% among the employed patients. For the general population, the corresponding values were 4.7% and 1.3%.

In logistic regression models predicting long SD, DIS, and FAT, with employment as a covariate, the results were similar to those without work as a covariate, although with weaker ORs. EMAs were still more frequent for young patients but not for middle-aged patients when working was a covariate.

Sleep Problems in a Representative Population Sample

We did also conduct an analysis within the Health 2000 sample to see whether our findings were replicable in a population-based sample. The findings in these analyses were largely the same as in our main analyses: The sleep problems were generally more common in persons with a psychotic disorder than in the unaffected individuals (Supplementary table 2). Long SD was more common in patients with schizophrenia, schizoaffective disorder, and bipolar disorder than in the unaffected population, whereas short SD was not more common in patients with psychotic disorders than in the unaffected population. Due to small sample sizes, some results did not reach statistical significance and CIs were wide.

Latent Class Analysis of Sleep Problems

We used LCA to create sleep classes based on the sleep properties for which patients deviated the most from the general population: long SD, DIS, EMAs, and FAT. The Bayesian information criterion and bootstrap likelihood ratio test both suggested three class models.

The first class had a low probability of sleep problems and was referred to as a relatively symptom-free class (figure 2). The second class consisted of patients with insomnia symptoms, where persons had reported EMAs, DIS, and FAT. In the third class, all patients had both long SD and FAT and it was therefore referred to as a hypersomnia symptoms class.

The entropy was 0.53, meaning that the identified classes are relatively overlapping. Average posterior probabilities for individuals in each group were 85% in persons in the relatively symptom-free class, 77% in persons in the insomnia class but only 56% in the hypersomnia class.

The latent class the patient was most likely to belong to was relatively symptom-free in 57.5% of the patients, insomnia in 27.2%, and hypersomnia in 15.3% of the patients (see figure 2B for diagnostic group split).

Sleep and Subjective Health

In our univariate general linear models, all sleep problems (long SD, short SD, DIS, EMAs, FAT, and poor SQ) had a significant association with worse subjective health. FAT and poor SQ had the strongest associations (B = 1.14, CI 1.06–1.22, $P < .001$ and B = 1.38, 95% CI 1.27–1.50, $P < .001$, respectively). All these results remained significant also with depressive mood as a covariate.

Discussion

In this large study of sleep problems among patients with psychotic disorders, we found that the patients had more sleep problems than the general population. The patients could be divided into three groups based on their sleep: relatively symptom-free patients, patients with insomnia symptoms, and patients with hypersomnia symptoms. Sleep problems were more common among women and young patients and they were associated with worse subjective health.

Regarding sleep duration, the findings differ from previous studies. Short SD was not more common in any diagnostic group compared with the general population, in contrast to previous research.[11,14,21] Long SD was the most deviating property of sleep among the patients compared with the general population, with increased prevalence in all diagnostic groups but especially among patients with schizophrenia and schizoaffective disorder. These results were replicated in a representative population sample with a small number of people with psychotic disorders. The remarkable prevalence of long SD in our sample is probably due to several reasons. Many antipsychotic medications prolong sleep.[6] The recently observed genetic correlation between long sleep and schizophrenia is also of interest in this context.[8] Low activity has also been linked to hypersomnia,[7] but it is also worth noting that the results stayed significant while taking the employment status into consideration. In bipolar disorder, long SD is associated with depressive

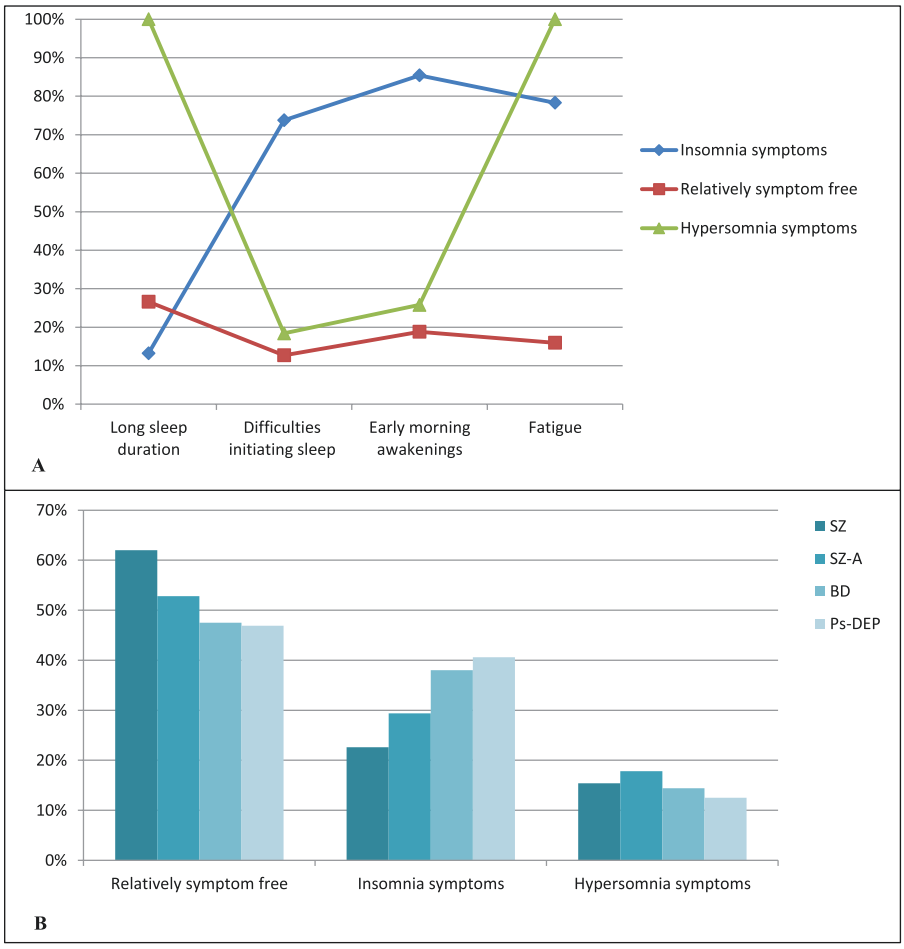

Fig. 2. (A) Prevalence of sleep problems in the three sleep clusters and (B) the diagnostic group representation in the three clusters. *Note*: SZ, Schizophrenia; SZ-A, Schizoaffective disorder; BD, Bipolar disorder; Ps-DEP, Psychotic depression.

periods.[11] The other sleep problems, including EMAs, DIS, and FAT, were experienced more in all diagnostic groups compared with the general population, in line with previous research involving patients with schizophrenia and bipolar disorder.[11,12,21] There has been little research on sleep in patients with schizoaffective disorder or psychotic depression. In our study, patients with schizoaffective disorder experienced sleep problems at a level between patients with schizophrenia and bipolar disorder, but closer to patients with schizophrenia. Young and middle-aged people with psychotic depression were the patients who reported most sleep problems, including DIS, EMAs, and FAT.

The results of the LCA suggest that patients with psychotic disorders have different sleep profiles with their own specific sleep problems and that an individual treatment plan for the sleep problems of a patient would therefore be needed. This reasoning is further strengthened by the findings of a small sample study of patients with schizophrenia and related psychoses, which also found three clusters based on sleep profiles (insomnia with normal sleep duration, classic severe insomnia, and insomnia with hypersomnia) and concluded that the two latter groups benefited the most from cognitive behavioral therapy for insomnia.[22]

All sleep problems were associated with worse subjective health, underlining the strong link between sleep symptoms and the patients' well-being.[9,23]

The study has some limitations and modifying factors that need to be considered. One obvious limitation is that the sleep reports are subjective. There is no conclusion on how strongly subjective and objective measurements of sleep correlate among psychiatric patients, with some studies saying that subjective sleep reports are a relatively reliable way to measure sleep problems and other studies opposing this idea.[24–26] Still, subjective sleep concerns have in previous studies been associated with worse life quality and in the present study with worse subjective health. Another limitation is that the sleep questionnaire was short and not validated. The questionnaire was based on the questions in the previously collected control sample, in order to enable comparisons with the general population. Regarding modifying factors, illness state, other health issues common in psychotic disorders, as well as psychiatric medications, including antipsychotic and sleep medications, affect sleep.[27] We were also not

able to take into account circadian dysfunction and clinical sleep disorders which are known to be prevalent in patients with psychotic disorders.[28,29] Lifestyle aspects such as substance use may affect sleep and are more common among patients with psychotic disorders.[30,31] These factors should be investigated in future studies.

One of this study's strengths is the large sample size. Furthermore, we could compare the results in the large SUPER study to a large and representative sample of the general population with a small number of persons with psychotic disorders.

Conclusions

In summary, patients with psychotic disorders have more sleep problems than the general population, including DIS, EMAs, FAT, and long SD. In our cohort, patients with schizophrenia and schizoaffective disorder experienced more hypersomnia symptoms compared with patients with bipolar disorder and psychotic depression, who experienced more insomnia symptoms. The results of the present study are important for understanding the different sleep profiles among patients with psychotic disorders and underline the strong association between sleep and subjective health. Future research should focus on investigating reasons for the sleep problems and on conducting studies with objective sleep measurements.

Supplementary Material

Supplementary data are available at *Schizophrenia Bulletin Open* online.

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References

1. Krystal AD. Psychiatric disorders and sleep. *Neurol Clin.* 2012;30(4):1389–1413.
2. Baglioni C, Nanovska S, Regen W, *et al.* Sleep and mental disorders: A meta-analysis of polysomnographic research. *Psychol Bull.* 2016;142(9):969–990.
3. Lieberman JA, Stroup TS, McEvoy JP, *et al.*; Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) Investigators. Effectiveness of antipsychotic drugs in patients with chronic schizophrenia. *N Engl J Med.* 2005;353(12):1209–1223.
4. Davies G, Haddock G, Yung AR, Mulligan LD, Kyle SD. A systematic review of the nature and correlates of sleep disturbance in early psychosis. *Sleep Med Rev.* 2017;31:25–38.
5. Robertson I, Cheung A, Fan X. Insomnia in patients with schizophrenia: current understanding and treatment options. *Prog Neuro-Psychopharmacol Biol Psychiatry.* 2019;92:235–242. doi:10.1016/j.pnpbp.2019.01.016
6. Monti JM, Monti D. Sleep in schizophrenia patients and the effects of antipsychotic drugs. *Sleep Med Rev.* 2004;8(2):133–148.
7. Reeve S, Sheaves B, Freeman D. Excessive sleepiness in patients with psychosis: an initial investigation. *PLoS One.* 2021;16(1):e0245301.
8. Dashti HS, Jones SE, Wood AR, *et al.* Genome-wide association study identifies genetic loci for self-reported habitual sleep duration supported by accelerometer-derived estimates. *Nat Commun.* 2019;10(1):1100.
9. Ritsner M, Kurs R, Ponizovsky A, Hadjez J. Perceived quality of life in schizophrenia: relationships to sleep quality. *Qual Life Res.* 2004;13(4):783–791.
10. Andriopoulos I, Ellul J, Skokou M, Beratis S. Suicidality in the "prodromal" phase of schizophrenia. *Compr Psychiatry.* 2011;52(5):479–485.
11. Harvey AG. Sleep and circadian rhythms in bipolar disorder: seeking synchrony, harmony, and regulation. *Am J Psychiatry.* 2008;165(7):820–829.
12. Wang CH, Chen KC, Hsu WY, *et al.* Sleep complaints and memory in psychotropic drug-free euthymic patients with bipolar disorder. *J Formos Med Assoc.* 2014;113(5):298–302. doi:10.1016/j.jfma.2012.05.011
13. Hofstetter JR, Lysaker PH, Mayeda AR. Quality of sleep in patients with schizophrenia is associated with quality of life and coping. *BMC Psychiatry.* 2005;5:13.

14. Thase ME, Kupfer DJ, Ulrich RF. Electroencephalographic sleep in psychotic depression. A valid subtype? *Arch Gen Psychiatry.* 1986;43(9):886–893.
15. Mander BA, Winer JR, Walker MP. Sleep and human aging. *Neuron.* 2017;94(1):19–36.
16. Carrier J, Semba K, Deurveilher S, *et al.* Sex differences in age-related changes in the sleep-wake cycle. *Front Neuroendocrinol.* 2017;47:66–85.
17. Aromaa A, editors KS. Health and functional capacity in Finland. Baseline Results of the Health 2000 Health Examination Survey. *Helsinki, Finl Publ Natl Public Heal Inst.* 2004;B12/2004.
18. Heistaro, Sami E. *Methodology Report. Health 2000 Survey.* Helsinki, Finland: Publications of the National Health Institute B26/2008. 2008. http://www.terveys2000.fi. Accessed February 25, 2020.
19. Partinen M, Gislason T. Basic Nordic Sleep Questionnaire (BNSQ): a quantitated measure of subjective sleep complaints. *J Sleep Res.* 1995;4(S1):150–155. doi:10.1111/j.1365-2869.1995.tb00205.x
20. Berwick DM. Controlling variation in health care: a consultation from Walter Shewhart. *Med Care.* 1991;29(12):1212–1225.
21. Kamath J, Prpich G, Jillani S. Sleep disturbances in patients with medical conditions. *Psychiatr Clin North Am.* 2015;38(4):825–841.
22. Chiu VW, Ree M, Janca A, Iyyalol R, Dragovic M, Waters F. Sleep profiles and CBT-I response in schizophrenia and related psychoses. *Psychiatry Res.* 2018;268:279–287.
23. Blom K, Jernelöv S, Rück C, Lindefors N, Kaldo V. Three-year follow-up comparing cognitive behavioral therapy for depression to cognitive behavioral therapy for insomnia, for patients with both diagnoses. *Sleep.* 2017;40(8). doi:10.1093/sleep/zsx108
24. Gonzalez R, Tamminga C, Tohen M, Suppes T. Comparison of objective and subjective assessments of sleep time in subjects with bipolar disorder. *J Affect Disord.* 2013;149(1–3):363–366. doi:10.1016/j.jad.2013.02.013
25. Kung PY, Chou KR, Lin KC, Hsu HW, Chung MH. Sleep disturbances in patients with major depressive disorder: incongruence between sleep log and actigraphy. *Arch Psychiatr Nurs.* 2015;29(1):39–42.
26. Argyropoulos SV, Hicks JA, Nash JR, *et al.* Correlation of subjective and objective sleep measurements at different stages of the treatment of depression. *Psychiatry Res.* 2003;120(2):179–190.
27. Monti JM, Torterolo P, Pandi Perumal SR. The effects of second generation antipsychotic drugs on sleep variables in healthy subjects and patients with schizophrenia. *Sleep Med Rev.* 2017;33:51–57.
28. Monti JM, BaHammam AS, Pandi-Perumal SR, *et al.* Sleep and circadian rhythm dysregulation in schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry.* 2013;43:209–216.
29. Reeve S, Sheaves B, Freeman D. Sleep disorders in early psychosis: incidence, severity, and association with clinical symptoms. *Schizophr Bull.* 2019;45(2):287–295.
30. Garcia AN, Salloum IM. Polysomnographic sleep disturbances in nicotine, caffeine, alcohol, cocaine, opioid, and cannabis use: a focused review. *Am J Addict.* 2015;24(7):590–598.
31. Hartz SM, Bierut LJ, Pato MT. In reply. *JAMA Psychiatry.* 2014;71(8):969.