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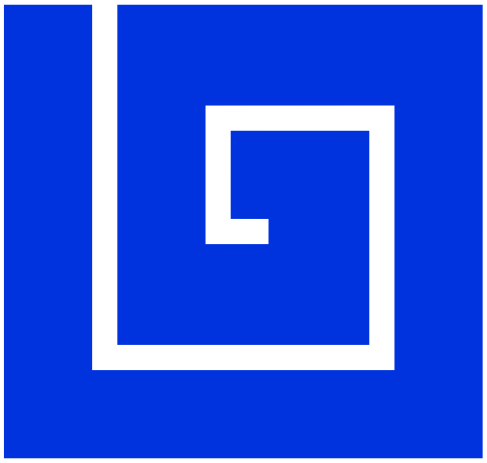
PSYCHIATRIA FENNICA



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EDITORIAL

TIMO PARTONEN, EDITOR IN CHIEF

FROM NOBEL PRIZE TO BEDSIDE

– "And the Nobel goes to … the circadian clock!"

On Monday 3 October 2017, The Nobel Assembly at Karolinska Institutet decided to award the 2017 Nobel Prize in Physiology or Medicine jointly to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of molecular mechanisms controlling the circadian rhythm (1, 2). Hall and Young graduated in biology and Rosbash in chemistry, but their research work using fruit flies as a model organism has borne fruit and contributed not only to medicine at large, but also to psychiatry.

– "The key fourth awardee here is, as some of us call them, the little fly." Jeffrey C. Hall popped up this flying sentence, or this tag, in his Nobel Lecture. The little fly refers to Drosophila melanogaster which was the model organism in their work. It is a diurnal animal being active during the day and sleeping during the night. Hall named a fifth awardee as well, and it was the rhythm itself. Why is the circadian rhythm a key to medical conditions or psychiatric disorders?

Circadian disruption is not a rare phenomenon affecting only shift workers or international travellers but is common in the general population, and therefore has broader implications for public health than is generally appreciated (3). Due to the east-to-west movement of the sun, increasing distance west within a time zone may be a source of circadian disruption through light exposure delaying the endogenous circadian phase, leading to misalignment between biological time and social time. Circadian disruption due to residence in a western region of a time zone may impact late ("night owls") more than early ("morning larks") chronotypes, the former having increased odds for a range of health hazards (4). Further studies to investigate the relationship of time zone position to, e.g., winter depression, insomnia, obesity, type 2 diabetes, cardiovascular endpoints and mortality are thus justified.

The three Nobel laureates were among the first to start mapping the genes which contribute to behaviours, so to begin the work in the field of behaviour genetics. However, they became the target of mockery and their work was ridiculed. Their approach to study circadian clocks was disparaged in public by others, even by other rhythm researchers, saying that they were wasting their time: the work was regarded as silly and maybe even worthless. For the great majority of their career people did not know about their work, or did not care about it, or if people knew a bit about it, it was seen as nonsense. Hearing this negativity, they decided to just keep going, because they wanted to, knew how to, thought their work was worth doing and found that there was almost no competition in the field and so the road was open to a treasure (5–7).

Because this is science, this journey of exploration continues, of course, all the time on the lines laid down by Rosbash (8), by Young (9) [Hall has retired,] and by many others as evidenced, e.g. in (10). Right now, we have seen the ignition but only have lift-off thus far. So, when and where will there be a landing, and by whom?

Timo Partonen
Editor-in-Chief, Psychiatria Fennica

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PSYCHOPHARMACOLOGICAL TREATMENT, MORTALITY AND SUICIDE IN BIPOLAR DISORDER IN A FINNISH NATIONWIDE COHORT OF 18,018 PATIENTS

ABSTRACT

Bipolar disease has been associated with high overall mortality and a marked decrease in life expectancy. Suicide is one of the most common causes of death in bipolar disorder. In recent years, use of antidepressants and anticonvulsants has increased at the expense of lithium in the treatment of this disorder. Not much "real-world" data from large inclusive cohorts is available to determine whether this switch in treatment preference could affect risk of suicide in bipolar patients. We aimed to study the risks associated with the use of pharmacological treatment on suicide and overall mortality in a nationwide cohort of Finnish patients with bipolar disorder (n=18018).

We studied the risk of overall and suicide mortality between 1996–2012 among all patients who had been hospitalized due to bipolar disorder in Finland (n=18018; mean follow-up time 7.2 years) using prospectively gathered nationwide databases for hospitalization and dispensed medication. The primary analysis was a Cox proportional hazards model. Analyses were adjusted for the effects of time since diagnosis, order of treatments, current use of other treatments, polypharmacy within medication group, number of hospitalizations within 2 years (indicator of inherent risk of relapse), age at index date, gender and calendar year of index date. Results are reported as hazard ratios (HRs) with 95% confidence intervals (95% CI).

In comparison between use and no use of medication groups reaching nominal statistical significance, use of mood stabilizers was associated with a 51% reduction in overall mortality (HR 0.49, 95% CI 0.44-0.54, p<0.001) and antidepressants with a 26% reduction in overall mortality (HR 0.74, 95% CI 0.67-0.81, p<0.0001). Use of mood stabilizers was associated with a 53% reduction in suicide mortality (HR 0.47, 95% CI 0.38-0.58, p<0.0001), whereas use of sedatives was associated with a significantly increased risk for suicide (HR 1.52, 95% CI 1.22-1.90, p=0.0002).

In conclusion, mood stabilizers should be considered as treatment of choice for patients with bipolar disorder who are at high risk for suicide. Use of sedatives should be avoided to the fullest extent possible.

KEY WORDS: PSYCHOPHARMACOLOGICAL TREATMENT; BIPOLAR DISORDER; MORTALITY; SUICIDE

INTRODUCTION

Bipolar disorder is a serious, chronic psychiatric disorder, which often leads to serious impairment and long-term symptoms, although individual disease course may vary (1). It is characterized by changes in mood and activity levels, either as elevated mood and increased energy and activity (hypomania or mania) or decreased energy and activity levels, often associated with depressive symptoms (The International Classification of Diseases, version 10, The World Health Organization). Both elevated and depressed states in bipolar disorder have been associated with an increased risk for suicidal behaviour, and indeed bipolar disorder has been regarded to carry the highest risk of suicide among major psychological disorders (2-4). Overall mortality is also increased in bipolar disorder compared with the general population, and it is thought to lead to a 9 to 20-year reduction in average lifespan (5-8). Bipolar disorder also accounts for the loss of more disability-adjusted life years than all cancers combined and is one of the most common causes of disability in the world (9). Thus, effective treatment for the disorder could lead to a greater reduction in patient suffering as well as cost to society. Long-term medication is often required to attain remission and to prevent relapse, although even with modern treatments remission rates remain low (10). Treatment regimes for bipolar disorder are varied, but medication most often used include mood stabilizers, antidepressants, antipsychotics, benzodiazepines and sedatives. However, not much data on the effects of these different medication groups in preventing suicide in bipolar patients exist, although at least one register-based study has recently studied this question in Finland with a sample of 826 bipolar patients (11). As prescription trends for bipolar disorder have shifted in recent years from the use of lithium salts towards other mood stabilizers, antipsychotics and even antidepressants, and an overall increase in the prescription of psychotropics has been noted, more research is needed to determine how this change could reflect on suicide rates, as lithium has been noted to be one of the best medications in preventing suicidal behaviour (12-15).

METHODS

STUDY DESIGN AND DATA ACQUISITION

Finnish databases nationwide were used to combine prospectively collected registry data in order to conduct a population-based cohort study of patients hospitalized due to bipolar disorder. The registers were used to identify the study cohort (patients hospitalized due to bipolar disorder between the years 1987 and 2012), to determine the incidence, duration and reasons for rehospitalizations, to obtain information on reimbursed medication dispensed from pharmacies (all psychotropic medications except small packages of benzodiazepines were reimbursed in this indication) and to retrieve information on causes of death. The databases and their usage have been described in more detail in our previous pharmacoepidemiological studies (16-20). In Finland, every individual has a unique identification code which makes it possible to track them even if they change their name or location of residence. All hospital treatments, deaths and prescriptions are documented in national databases. The current study included every subject (n=18018) hospitalized at least once with a bipolar disorder diagnosis (ICD-10 diagnoses F30-31, Finnish ICD-9 diagnoses 2962-2964 and 2967A) between January 1st, 1987 and December 31st, 2012, who had not been diagnosed with broadly defined schizophrenia during this time period (ICD-10: F20–29, ICD-9: 295, 2971A, 2973A, 2988A, 2989X, 3012C) and who were still alive at the start of the observation period. A total of 25860 subjects were initially identified, but 7758 were excluded due to having schizophrenia as described above, 77 excluded due to death before start of observation period and 7 excluded due to not having any follow-up time (cohort entry at the end of the observation period). Cohort entry date was set as January 1st, 1996 for subjects hospitalized due to bipolar disorder between January 1st, 1987 and December 31st, 1995, and as the first hospital discharge date for subjects hospitalized for the first time on January 1st, 1996. The cohort is described in detail in *Table 1*.

EXPOSURE

The PRE2DUP method was used to define exposure and non-exposure periods for medications (17). PRE2DUP calculates current dose with a sliding average, uses package information such as number of tablets and administration intervals for injections, and takes into account stockpiling when constructing time periods of continuous use. Our previous publications on the validity of the method indicate that PRE2DUP is the most precise method currently available to estimate drug use, and it gives highly accurate drug use periods for most drug classes, especially those meant for long-term use (16-18). As variation in dose is allowed within the method, no artificial grace periods are used. Thus, the risk is attributed to the ongoing treatment(s), according to the

PRE2DUP method, for each day. Periods of cross-titration and actual polypharmacy (with two or more medications used concomitantly), not recorded in the register-based data, include somewhat more uncertainty. Antipsychotics were defined as ATC code N05A, except for N05AN01 (lithium), antidepressants as N06A, mood stabilizers as N03AF, N03AG, N03AX and N05AN01 (lithium), benzodiazepines as N05BA, and finally sedatives as N05C.

STATISTICAL ANALYSIS

Two analyses were performed on the cohorts: risk association of use of medication with either mortality due to any cause or suicide, using a between-group (users and non-users) Cox proportional hazards analysis. The analyses were corrected for the effect of time since diagnosis, order of treatments, current use of other treatments and polypharmacy, number of hospitalizations within 2 years (any-cause hospitalization for overall mortality and suicidal hospitalization for suicide mortality, indicator of inherent risk of relapse), age at index date, gender and calendar year of index date. The analysis is further described in *Table 2*. A p-value of <0.01 was deemed statistically significant (due to Bonferroni correction for multiple comparisons).

ETHICAL CONSIDERATIONS

The research project was approved by the Ethics Committee of the Finnish National Institute for Health and Welfare (dated December 4, 2013, 8/2013). Further permissions were granted by pertinent institutional authorities at the Finnish National Institute for Health and Welfare (permission THL/1466/6.02.00/2013), The Social Insurance Institution of Finland (34/522/2013) and Statistics Finland (TK53-305-13).

RESULTS

The sociodemographic, clinical and treatment characteristics of the total and the incident cohorts are shown in *Table 1*. The study cohort consisted of 18018 individuals with a total observation time of 129740 person years, with a mean observation (follow-up) time of 7.2 years (range 1 day to 17.0 years). During this time period we observed a total of 2910 deaths due to any cause (~22.43 events/1000 person years), of which 477 were due to suicide (~3.68/1000 person years).

When comparing use versus non-use of certain medication groups (the risk of using a medication from a certain group or not using a medication from that group) in this patient group of bipolar patients hospitalized at least once due to bipolar disorder, differences in hazard ratios (HR) for death started to emerge.

Results for overall mortality are shown in *Table 3*. Use of benzodiazepines or sedatives was not associated with significant changes in overall mortality versus not using these medications (HR 0.98, 95% CI 0.89-1.08, p=0.69 for benzodiazepines and HR 1.09, 95% CI 0.99-1.21, p=0.07 for sedatives). Use of mood stabilizers was associated with a 51% reduction in overall mortality (HR 0.49, 95% CI 0.44-0.54, p<0.001), antidepressants with a 26% reduction in overall mortality (HR 0.74, 95% CI 0.67-0.81, p<0.0001) and antipsychotics with a 11% reduction in overall mortality (HR 0.89, 95% CI 0.81-0.98, p<0.02), although the results for antipsychotics are not statistically significant when corrected for multiple comparisons (significance level p<0.01).

Results for suicide mortality are shown in *Table 4*. Use of benzodiazepines or antipsychotics was not associated with significant change in risk for suicide (HR 1.21, 95% CI 0.97-1.51, p=0.10 for benzodiazepines and HR 1.15, 95% CI 0.91-1.43, p=0.24 for antipsychotics). Use of mood stabilizers was associated with a 53% reduction in suicide mortality (HR 0.47, 95% CI 0.38-0.58, p<0.0001). Use of sedatives and antidepressants was associated with a significantly increased risk for suicide (HR 1.52, 95% CI 1.22-1.90, p=0.0002 for sedatives and HR 1.28, 95% CI 1.02-1.61, p=0.03 for antidepressants), although the results for antidepressants are not statistically significant when corrected for multiple comparisons (significance level p<0.01).

Covariates	Patient counts (%)
Gender	
female	9558 (53.05%)
male	8460 (46.95%)
Age at cohort entry date	
<30	3345 (18.56%)
30-49	7121 (39.52%)
50-69	5577 (30.95%)
70	1975 (10.96%)
Calendar year of cohort entry date	
1996-1999	5107 (28.34%)
2000-2003	3102 (17.22%)
2004-2007	4280 (23.75%)
2008-2012	5529 (30.69%)
Patients remaining in cohort after censoring hospitalization longer than 30.5 days	
no	105 (0.58%)
yes	17913 (99.42%)
Patients remaining in cohort after censoring hospitalization longer than 0 days	
no	141 (0.78%)
yes	17877 (99.22%)
Time since diagnosis at CED (years)	
0-5	16531 (91.75%)
5-10	1472 (8.17%)
>10	15 (0.08%)
Time since diagnosis at end of follow-up (years)	
0-5	7120 (39.52%)
5-10	5357 (29.73%)
>10	5541 (30.75%)
Two years history of any-cause hospitalization at cohort entry date	
0	1364 (7.57%)
1-2	12129 (67.32%)
>2	4525 (25.11%)

Table 1 (1/2): Characteristics of the study cohort.

Covariates	Patient counts (%)
Two years history of any-cause hospitalization at end of follow-up	
0	7321 (40.63%)
1-2	6756 (37.50%)
>2	3941 (21.87%)
Two years history of any psychiatric hospitalization before cohort entry date	
0	1777 (9.86%)
1-2	14097 (78.24%)
>2	2144 (11.90%)
Two years history of any psychiatric hospitalization at end of follow-up	
0	10997 (61.03%)
1-2	5312 (29.48%)
>2	1709 (9.48%)
Use of benzodiazepines during follow-up	
no	8580 (47.62%)
yes	9438 (52.38%)
Use of sedatives during follow-up	
no	8069 (44.78%)
yes	9949 (55.22%)
Use of mood stabilizers during follow-up	
no	4749 (26.36%)
yes	13269 (73.64%)
Use of antidepressants during follow-up	
no	4832 (26.82%)
yes	13186 (73.18%)
Use of antipsychotics during follow-up	
no	3413 (18.94%)
yes	14605 (81.06%)
Total	**18018 (100.00%)**

Table 1 (2/2): Characteristics of the study cohort.

Treatment studied		**Drug classes:** **Benzodiazepines, Sedatives, Antidepressants, Antipsychotics, Mood stabilizers**
Adjusting covariates	**Time since diagnosis**	Time since diagnosis (0-5 ,5-10,>10 years)
	Order of treatment	Order of drug classes (0-1,2,>2; cumulative number of different drug classes)
	Current use of other treatments	Current use of other drug classes (yes/no; for each drug class separately)
	Polypharmacy	Polypharmacy (yes/no; concurrent use of more than one drug class)
	Number of hospitalizations within 2 years	Number of hospitalizations due to any cause/suicide within a 2-year period (0,1-2,>2)
	Age at index date	Age at index date (<30,30-49,50-69,>70 years)
	Gender	Gender (Female/male)
	Calendar year of index date	Calendar year of index date (1996-1999,2000-2003,2004-2007,2008-2012)

Table 2: Statistical analysis and adjusting variables.

Covariates	HR estimate	95% confidence interval	p-value
Medication classes:			
benzodiazepines	0.98	(0.89 - 1.08)	0.68818
sedatives	1.09	(0.99 - 1.21)	0.07144
mood stabilizers	**0.49**	(0.44 - 0.54)	<0.0001
antidepressants	**0.74**	(0.67 - 0.81)	<0.0001
antipsychotics	0.89	(0.81 - 0.98)	0.01979
Gender:			
Female	reference	reference	reference
Male	1.84	(1.71 - 1.99)	<0.0001
Age at cohort entry (years):			
<30	reference	reference	reference
30-49	1.85	(1.54 - 2.22)	<0.0001
50-69	3.44	(2.87 - 4.11)	<0.0001
>70	9.00	(7.48 - 10.82)	<0.0001
Calendar year of cohort entry:			
1996-1999	reference	reference	reference
2000-2003	0.97	(0.87 - 1.08)	0.59337
2004-2007	0.80	(0.71 - 0.90)	0.00023
2008-2012	0.84	(0.73 - 0.98)	0.02439
Time since diagnosis (years):			
0-5	reference	reference	reference
5-10	1.27	(1.09 - 1.47)	0.00155
>10	1.26	(1.04 - 1.53)	0.01876
Number of medication classes used previously:			
0-1	reference	reference	reference
2	0.90	(0.79 - 1.04)	0.14458
>2	1.28	(1.13 - 1.45	<0.0001
Polypharmacy of medication classes:	0.97	(0.84 - 1.13)	0.70114
Number of all-cause hospitalizations within 2-year interval:			
0	reference	reference	reference
1-2	3.20	(2.86 - 3.59)	<0.0001
>2	9.02	(8.05 - 10.11)	<0.0001

Table 3: Analysis of risk of all-cause mortality associated with use vs. no-use of medication classes. Hazard rations (HRs) still statistically significant after Bonferroni correction for multiple comparisons are bolded.

Covariates	HR estimate	Confidence interval	p-value
Medication classes: benzodiazepines	1.21	(0.97 - 1.51)	0.09774
sedatives	**1.52**	(1.22 - 1.90)	0.00020
mood stabilizers	**0.47**	(0.38 - 0.58)	<0.0001
antidepressants	1.28	(1.02 - 1.61)	0.03041
antipsychotics	1.15	(0.91 - 1.43)	0.23775
Gender:			
Female	reference	reference	reference
Male	2.08	(1.73 - 2.52)	<0.0001
Age at cohort entry (years):			
<30	reference	reference	reference
30-49	0.86	(0.65 - 1.13)	0.26866
50-69	0.82	(0.61 - 1.10)	0.18685
>70	0.22	(0.12 - 0.41)	<0.0001
Calendar year of cohort entry:			
1996-1999	reference	reference	reference
2000-2003	0.75	(0.58 - 0.96)	0.02310
2004-2007	0.45	(0.34 - 0.60)	<0.0001
2008-2012	0.45	(0.33 - 0.62)	<0.0001
Time since diagnosis (years):			
0-5	reference	reference	reference
5-10	0.79	(0.54 - 1.14)	0.19971
>10	0.65	(0.37 - 1.14)	0.13171
Number of medication classes used previously:			
0-1	reference	reference	reference
2	1.51	(0.99 - 2.31)	0.05585
>2	3.03	(2.05 - 4.48)	<0.0001
Polypharmacy of medication classes:	1.09	(0.76 - 1.56)	0.63275
Number of suicidal hospitalizations within 2 year interval:			
0	reference	reference	reference
>0	1.86	(0.26 - 13.40)	0.53929

Table 4: Analysis of risk of suicide mortality associated with use vs. no-use of medication classes. Hazard rations (HRs) still statistically significant after Bonferroni correction for multiple comparisons are bolded.

DISCUSSION

To our knowledge, this is the first comprehensive Finnish nationwide study on the risk correlations for use of psychotherapeutics and overall mortality and suicide in bipolar patients hospitalized at least once due to their disorder. A previous study in Finland has evaluated the risks for medication use versus mortality rates in a cohort of 826 bipolar patients hospitalized due to previous suicide attempt (11). The main results of our study are well in line with the previous smaller study, and indicate that use of mood stabilizers is associated with the lowest risk for overall and suicide mortality in bipolar patients. Use of antidepressants was also associated with a reduced risk for overall mortality, whereas use of sedatives was associated with an increased risk for suicide mortality.

Although our study was comprehensive, which is one of the key strengths of this study, any results obtained should be interpreted with caution. The study population included only Finns, so while the results are very much valid inside Finland they might not be generalizable to other countries. Also, as mortality and suicide are one-time events, more advanced within-individual analyses could not be performed, and so confounding by factors inherent to the contributing individuals (such as genetics or degree of illness) could not be controlled for. However, especially for one-time events, the overall change in the prevalence of these events as time goes by needs to be corrected for, as was recently shown in a large register-based study exploring the temporal trends in suicide mortality in depression patients in Finland between 1991 and 2014 (21). We used information on time since diagnosis, age at index date and calendar year of index date to try to correct for different temporal trends. Between-group analyses are often also fraught with residual confounding due to selection bias, which arises from the fact that patients most mildly ill often use less or no medication, whereas patients with more pronounced symptoms and severe course of disease often have more medication prescribed. As this study compares the use of a certain medication group to non-use of the same medication group, the results could also be influenced by protopathic bias. This is a form of bias which arises when medications are often added when the patient experiences a worsening of his/her symptoms. Thus, the medications in use at time of death might not have contributed to the mortality event, but rather have been initiated too late to have been able to stop it. This protopathic bias can be controlled for by excluding time periods right after initiation of new treatments, but doing so would markedly decrease the number of suicide events available for analysis, as suicides are often completed during or right after hospitalization (22) when medications are also often initiated. Also, as this study is based on information gained from registers, no data on clinical variables, such as smoking or alcohol use or substance abuse, were obtained or available for analysis.

Our results indicate that, as a therapeutic group, mood stabilizers are associated with the lowest risk of any-cause and suicide mortality in bipolar patients. With respect to previous findings by ourselves and others (12, 13, 15, 20, 23-27) and the new findings presented here, these medications should be considered as first choice for bipolar patients requiring hospitalization for their disorder, not only to prevent rehospitalization, but also mortality. Patients at a high risk for suicide should be especially considered for treatment with mood stabilizers. However, when considering a patient for this group of medication, their side-effect profile and tolerability should also be taken into consideration.

It would also seem clear in light of our current findings that the use of sedatives should be avoided where possible, as their use was associated with an increased risk for suicide. As this study is of an observational nature, no direct causation can be drawn from the data, and one explanation could be that patients using sedatives suffer from sleep disorders and are thus at a higher risk for suicide and mortality, and at least part of the risk association shown here comes from the effect of the sleep disorder rather than the use of sedatives. If this were the case, one would also expect to see the same association with other medication groups with sedative properties often used to treat sleep disorders, such as benzodiazepines or antipsychotics. However, this association did not surface in this study. Lending credence to the risk associated with use of sedatives is the fact that an increased risk for overall mortality has previously been reported by other groups for the use sedatives (28-30), although our study did not find such an association. Use of sedatives has been associated with an increased risk for an excess of death at night (31), excess of infection (32) and chronic obstructive pulmonary disease (33), excess of specific cancers, such as lung and oesophagus (34), as well as an excess of suicide death (35) (36).

Although use of benzodiazepines for bipolar patients has previously been associated with a higher risk for rehospitalization (20), suicide mortality (28) as well as overall mortality (29), we did not find an association for significantly increased risk for overall or suicide mortality in this study. An explanation could be that this study was underpowered to detect changes in risk for benzodiazepine use, as the number of suicides was rather low even in this

large cohort, since use of benzodiazepines seemed to be associated with a non-significant trend towards an increased risk. The difference may also arise from different definitions of benzodiazepines between the studies, for example, our definition of "sedatives" also included some benzodiazepines commonly used as hypnotics. Further studies are required to obtain further information on this subject. However, as data on the harmful effects of long-term benzodiazepine use are becoming more and more prominent, great care should be taken when prescribing these medications by making sure they remain in use for only as long as absolutely necessary.

In conclusion, one of the major shortcomings of this study is that data on treatment effectiveness were only analysed on a group-wise level. As individual medications inside medication groups can have markedly different effects, translating these results into clinical practice is difficult. Some inferences can be made, however, as the use of mood stabilizers in this Finnish cohort of patients with bipolar disorder was associated with the lowest risk for all-cause mortality and suicide mortality, and as these medications have also previously been associated with lowest risk of rehospitalization due to mental disorder, they would seem to be the obvious first choice to be considered for the treatment of bipolar disorder. In this study, use of sedatives was associated with an increased risk for suicide mortality, and should thus be avoided in patients at a high risk for suicide.

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RETURN TO WORK AND FUNCTIONAL CAPACITY OF PSYCHIATRIC PATIENTS: CLINICAL ASSESSMENT TOOLS AS PREDICTORS OF RETURNING TO WORK

ABSTRACT

Subjective functional capacity is of prognostic value regarding work outcomes. The Sheehan Disability Scale (SDS) and the Return-to-Work Self-Efficacy (RTW-SE) questionnaire are validated tools to measure dimensions of subjective functional capacity and they can be used in rehabilitation planning. The aim of our study was to assess the SDS and RTW-SE measures in predicting the working status after one year of follow-up among psychiatric patients undergoing assessment of work ability.

This cohort study involved 104 consenting patients with multifactorial disabilities referred for a thorough psychiatric examination concerning work ability. At the one-year follow-up, 93 patients were reached for a telephone interview.

SDS and RTW-SE measures both independently predicted better work outcomes after one year. Having employment at baseline and being off from work for less than 6 months were associated with better work outcomes. Higher education and being off from work for less than 6 months were associated with more positive estimations of one's work capacity.

Considering the predictive value for work status, both the SDS and the RTW-SE questionnaires are usable tools for the evaluation of working capacity, opening dialogue regarding the subjective and psychosocial aspects affecting psychiatric rehabilitation and recovery.

KEY WORDS: FUNCTIONAL ABILITY, PSYCHIATRIC PATIENTS, RETURN TO WORK, SELF-EFFICACY, SDS, SELF ASSESSMENT, WORK ABILITY

INTRODUCTION

Up to 38.2% of the total population in the European Union suffer from a mental disorder and two-thirds of them do not receive any treatment (1). There is little doubt that mental disorders rank together as the most disabling group of all medical disorders because of the combination of high prevalence and associated diagnosis-specific impairments and disabilities. The disability burden manifests in indicators such as years lived with disability, lost work days, disability pensions, work productivity and quality of life. Depression is the single most important contributor to the total disease burden, but surprisingly, less serious mental disorders also result in a substantial degree of disability [1]. A mental health problem, as opposed to a physical health problem, is related to a longer duration of time off work among employees on sick leave (2).

Fossey and Harvey (3) concluded that suitable work improves the mental health of people with serious psychiatric conditions by providing structure, social contact and a sense of purpose. The same has been concluded regarding those with common mental disorders (4, 5). Thus, keeping patients suffering from psychiatric morbidity in an active workforce is important. For those outside an active workforce, tailor-made forms of multidisciplinary interventions are needed to promote return to work (RTW) in order to prevent permanent disability (6). Such forms of intervention improve quality of life by establishing circadian rhythms, increasing functional capacity and improving low levels of self-esteem.

Some patients suffering from psychiatric morbidity have been found to be scared of returning to work, and they then develop stress and anxiety (7, 8). Relevant authorities and occupational healthcare professionals both assess fitness for work and plan interventions for RTW, thereby leaving no control to the individual. This may further increase the sense of insecurity related to RTW (8, 9). Andersen et al. (10) concluded in their meta-synthesis that employees with common mental disorders were able to identify several obstacles and facilitators of RTW related to their own personalities, social support at the workplace and social and rehabilitation systems. However, these employees found it difficult to determine the right time for RTW and experienced difficulties in implementing RTW solutions at the workplace.

Millward et al. (11) suggested that the mental healthcare system could have a negative effect on the RTW process, as interventions and healthcare professionals may reinforce the illness and non-work identity of the affected individuals by focusing too narrowly on the symptoms and illness instead of their own resources. On the other hand, focusing on the remaining work capacity and giving less emphasis to the symptoms may prevent adoption of an incapacitating illness role identity. However, individual work capacity is difficult to measure objectively in cases of mental health problems, unless a proper work trial in a real work environment is organized (12). In addition to the limited availability of objective methods, we need to explore the value of subjective measures of work capacity for individuals with mental health problems and how they relate to RTW. Self-reported 'readiness for RTW' measures have been shown to be robust predictors of actual RTW (13). In addition, the assessment process helps the patient to focus on his/her remaining functional capacity, thereby decreasing the importance of remaining symptoms.

In addition to precise diagnoses and treatment, there is a need for easy office-based tools to assess subjective functional capacity in order to plan the rehabilitation process and assess the optimal time for RTW. The Sheehan Disability Scale (SDS), which gives separate scores for work/school activities, social activities and family life, has been widely used to provide a self-reported disability score (14, 15), but it has not been used in relation to RTW. In contrast, the Return-to-Work Self-Efficacy (RTW-SE) measure has proved to be a robust predictor of RTW among employees with common mental disorders (16, 17) and among employees on sick leave for any cause (18). However, it has not been used in a diverse and severe psychiatric patient group. The SDS describes the subjective experience of current functional capacity, whereas the RTW-SE questionnaire describes individuals' future expectations.

The aim of our study was to determine if SDS and RTW-SE scores predict working status after one year of follow-up in a sample of Finnish psychiatric patients referred for assessment of occupational capacity and rehabilitation in connection with long-term and unclear problems of function at work. The study hypothesis was that both test results predict RTW.

MATERIALS AND METHODS

This study was conducted among patients referred for a thorough psychiatric examination of work ability at the Helsinki University Central Hospital Psychiatric outpatient unit for assessment of function and capacity. The referrals were made by occupational practitioners, the psychiatrist in charge of treatment or insurance companies, in cases of prolonged or severe disability with a probable mental

health origin and/or a functional status in disagreement with clinical diagnosis. A psychiatrist had previously evaluated all patients, but further assessments of work ability were judged to be necessary. All patients were unable to perform their designated work at the time of evaluation.

A multidisciplinary team, consisting of a psychiatric nurse, a social worker, an occupational therapist, a psychologist and a psychiatrist, conducted the evaluation. The process also typically included a meeting with the employer, the provider of occupational healthcare and a close informant, for example a family member. With unemployed patients, we contacted officials of public employment services. The duration of the evaluation was 1–2 months.

The examination by the team included the assessment of work ability and function, as well as a re-evaluation of differential diagnoses, illness severity, subtyping and comorbidity. Based on this examination, the team designed a new treatment and rehabilitation plan with realistic goals, including vocational rehabilitation whenever possible.

A total of 107 patients were assessed between 20 Sept 2011 and 20 Dec 2012 (a 15-month period). Of these, 104 patients gave their consent to participate in follow-up. One year after their baseline examination 93 patients were reached for a telephone interview. An analysis was performed on the dropout group consisting of 11 patients.

MEASURES

The main outcome measure was returning to work by the end of the follow-up time of one year (yes or no). The criteria for working included full-time work, part-time work (50%), work trials and freelance work (when sufficient for making a living). The main predictive questionnaires used were the SDS and RTW-SE. Both were used at the time of evaluation (baseline measurement) with the SDS also used at the one-year follow-up interview.

The SDS includes values from 0 to 10, where 0 stands for the best functional capacity with no deficit (14, 15). The SDS gives separate scores for work/school activities, social activities and family life. In addition, we calculated a mean SDS score based on all three subscales. The reliability coefficient Cronbach´s alpha for SDS Mean was 0.83.

The RTW-SE measure is based on an individual's belief in his/her ability to successfully meet the demands of the workplace and return to work (19). Lagerveld et al. (16) formulated the concept of the RTW-SE into 11 questions concerning RTW and vocational rehabilitation. The questionnaire explores whether an individual has the ability to meet the demands of his/her job if going back to full contract hours the next day. We used this RTW-SE 11-item questionnaire at baseline. The participants were asked to respond to statements about their jobs, imagining that they would start working full hours the next day in their present emotional state/state of mind. We used a modified scale with possible scores for each question ranging from 0–6. Higher scores reflect higher self-efficacy levels. The RTW-SE measure was calculated as a mean score of all items in the scale.

In addition to the above, we examined how different background factors affected the outcome. The background factors assessed were age, gender, level of education, employment status, diagnosis and time off work for any reason at the time of baseline evaluation.

In this study the level of education was divided into four groups: primary school, high school, college or university. In the analysis we also used a dichotomous variable (university or non-university). Age was investigated as a linear factor, as well as a dichotomous variable with a cut-off point at 50 years of age (≤50 years versus >50 years). The primary diagnoses were categorized as psychotic disorders, mood disorders, anxiety and all other diagnoses. The source of income at baseline was categorized into six groups: compensation for sick leave, temporary pension benefits, unemployment benefits, insurance company-provided compensation for vocational rehabilitation, salary or no compensation because of refused disability compensation claims.

STATISTICAL ANALYSIS

SDS Mean was the mean value of the three SDS subscales. To check the reliability, the Cronbach's alpha for SDS Mean was computed.

Since all of our measurements were not normally distributed, we used Wilcoxon's paired sample test (instead of the paired t-test) to compare baseline and follow-up measurements. Wilcoxon's two sample test was applied when comparing the measurements of two study groups (i.e. those who have returned to work and those who have not). When examining the relationship between SDS and RTW-SE scores, we applied Spearman's correlation coefficient (ρ). A p-value of <0.05 was considered statistically significant. The Bonferroni corrected critical values have also been presented.

We applied logistic regression analyses when predicting return to work via SDS and RTW-SE scores. We then calculated the odds ratios (ORs) and their 95% confidence intervals (CIs). Our model building strategy was as follows:

first, estimate the crude models, then add background variables one by one into the models.

A receiver operating characteristic (ROC) curve was also analysed for SDS and RTW-SE. An ROC curve demonstrates the true positive rate against the false positive rate for different cut-points of a scale. The cut-point was calculated with the Youden index. The accuracy of the test depends on how well it divides the sample into two groups (i.e., how well it predicts RTW in this case). The area under the curve (AUC) tells the accuracy of the test: an excellent test has an AUC of 1.0 and a worthless test an AUC of 0.5.

All analyses were carried out using IBM SPSS Statistics software version 22.

RESULTS

PATIENT CHARACTERISTICS

The mean age was 45 (SD 9.6). The most frequent main diagnosis was a mood disorder (51%), followed by anxiety (17%) and psychotic disorders (7%). At baseline, 33 patients (32%) were on sick leave, 22 patients (21%) received a temporary pension benefit, 24 patients (23%) received unemployment benefits, two patients (2%) were in vocational rehabilitation and three patients (3%) were partly at work but unable to perform. The remaining 20 patients (19%) had had their claims for disability compensations refused.

Eleven patients were not reached for follow-up. These patients do not differ from the reached patients except for gender. A summary of the background factors is included in *Table 1*.

RETURN TO WORK OUTCOME

Return to competitive work was reported by 25 (27%) of the 93 subjects reached by telephone at the one-year follow-up. Of these, 17 patients had a permanent employment status, while three patients had work trials (insurance company-supported vocational rehabilitation) and five patients had freelance work combined with community or insurance company income support. The remaining 68 patients were not working. A permanent disability pension had been granted to 17 patients, 23 patients had a temporary disability benefit and 28 patients were outside of working life because of unemployment or their own decision.

PREDICTIVE VALUE OF BACKGROUND FACTORS

The association between background factors and RTW is presented in Table 1. Having a workplace to return to at baseline was associated with successful RTW ($p=0.007$). A short time off work (less than six months) was also associated with RTW ($p<0.0005$). Educational level, gender, age or diagnosis were not associated with the return to work outcome.

VALUES OF SDS AND RTW-SE SCORES

SDS and RTW-SE scores for baseline and SDS scores for follow-up are shown in *Table 2*. The mean SDS score at baseline was 6.7, improving to 4.7 at follow-up, and the range for both was 0–10. Improvement in the SDS score after one year correlated with return to work. The mean RTW-SE score at baseline was 2.4 (range 0–6). RTW-SE and SDS scores were significantly better among patients with psychotic disorders than among those with mood and anxiety disorders.

Both RTW-SE and SDS scores showed significantly better functional capacity when the patient had been off work for less than six months and also when the patient had an academic education. Subjective occupational function, as assessed by the SDS Work subscale, was significantly worse in male patients, but the other SDS subscales of function and the RTW-SE score did not show any difference between genders.

The RTW-SE score correlated strongly with the SDS score in two-tailed Spearman correlation analysis (ρ-0.63, $p<0.0005$).

PREDICTIVE VALUES OF SDS AND RTW-SE SCORES IN RELATION TO RTW

The mean values and predictive values (ORs) of the SDS and RTW-SE scores in relation to return to work are presented in *Table 3.* The sample was divided into two groups based on the return to work outcome.

The SDS has a reversed scale, with higher points meaning lower functional capacity, and therefore the OR for SDS in predicting RTW is less than 1.0. The baseline SDS predicted RTW by the one-year follow-up (OR 0.67, 95% CI 0.54-0.83), as did all three SDS subdomains: work activity (OR 0.71, 95% CI 0.59-0.89), social activity (OR 0.75, 95% CI 0.64-0.89) and family life (OR 0.78, 95% CI 0.67-0.92). The mean SDS score at follow-up was also associated with RTW (OR 0.72, 95% CI 0.59- 0.87). The RTW-SE score independently predicted successful return to work (OR 1.76,

95% CI 1.25-2.49). In the adjusted logistic regression model, the significance of both tools predictive value remained strong.

DISCRIMINATIVE ANALYSIS

In the ROC analysis, the mean SDS sensitivity was 71% and specificity 72% with a cut-point of 6.83 for RTW. There were 39 patients with an SDS less than 6.83; of these, 18 patients (46%) were working at follow-up. The AUC for SDS was 0.77 (95% CI 0.66-0.88).

The RTW-SE sensitivity was 60% and specificity 68% with a cut-point of 2.55 for RTW. There were 36 patients with an RTW-SE score more than 2.55; of these, 15 patients (42%) were working at follow-up. The AUC for RTW-SE was 0.72 (95% CI 0.61-0.84).

	At baseline n=104	Return to work No n=68 (65%)	Return to work Yes n=25 (24%)	p-value o)	Dropouts n=11 (11%)
Gender				0.9277	
Male	40	28 (70%)	10 (25%)		2 (5%)
Female	64	40 (63%)	15 (23%)		9 (14%)
Age				0.6146	
under 50	64	42 (66%)	14 (22%)		8 (12%)
50 and over	40	26 (65%)	11 (27%)		3 (8%)
Employment				0.0073	
No	57	43 (75%)	8 (14%)		6 (11%)
Yes	47	25 (53%)	17 (36%)		5 (11%)
Education				0.1414	
Non-university	85	58 (68%)	18 (21%)		9 (11%)
University	19	10 (52%)	7 (37%)		2 (11%)
Time off work				<.0001	
Less than 6 months	31	12 (39%)	16 (51%)		3 (10%)
More than 6 months	73	56 (77%)	9 (12%)		8 (11%)
Diagnosis (primary)					
F20-F29 Schizophrenia, schizotypal and delusional disorders	10	6 (60%)	1 (10%)		3 (30%)
F30-F39 Mood disorders	60	39 (65%)	16 (27%)		5 (8%)
F40-F49 Neurotic, stress-related and somatoform disorders	19	15 (79%)	3 (16%)		1 (5%)
All other diagnoses	15	8(54%)	5(33%)		2 (13%)

o) The Bonferroni corrected critical value is $p<0.01$. The Wilcoxon two sample test was used to compare RTW vs. non-RTW groups.

Table 1. Background variables at baseline and their association with working life activities after one year of follow-up for psychiatric patients referred for assessment of work ability and rehabilitation evaluation.

	Baseline				Follow-up		Change		95% CI
	All		Follow-up completed						
	n	mean (SD)	*n*	mean (SD)	*n*	mean (SD)	Δ	p-value o)	
SDS Mean	102	6.7 (2.4)	90	6.7 (2.5)	90	4.7 (2.8)	2.0	<.0001	1.5–2.5
SDS Work	102	7.7 (2.6)	90	7.6 (2.7)	90	6.0 (3.5)	1.7	<.0005	1.1–2.4
SDS Social	102	6.5 (2.8)	90	6.6 (2.9)	90	4.4 (3.1)	2.3	<.0005	1.7–2.9
SDS Family	102	5.8 (2.9)	90	5.8 (3.0)	90	3.8 (2.7)	2.1	<.0005	1.5–2.7
RTW-SE	102	2.4 (1.5)	91	2.4 (1.5)					

o) The Bonferroni corrected critical value is p<0.0125. Statistical significance for the change was assessed with Wilcoxon's paired sample test.

Table 2. Subjectively reported functional capacity (SDS and RTW-SE scores) at baseline for the whole study group, and for those with complete follow-up data.

	RETURN TO WORK				
	No		Yes		
	n=68		*n*=25		
	Mean	(SD)	Mean	(SD)	OR (95% CI)
SDS Mean	7.3	(2.1)	4.9	(2.6)	0.67 (0.54-0.83)
SDS Work	8.3	(2.1)	5.7	(3.3)	0.71 (0.59-0.89)
SDS Social	7.2	(2.6)	4.9	(2.9)	0.75 (0.64-0.89)
SDS Family	6.4	(2.6)	4.3	(3.3)	0.78 (0.67-0.92)
RTW-SE	2.0	(1.4)	3.2	(1.6)	1.76 (1.25–2.49)

Table 3. Functional capacity (SDS and RTW-SE) at baseline for the two groups (return to work vs. no return to work at follow-up) among psychiatric patients referred for assessment of work ability and rehabilitation evaluation.

DISCUSSION

In psychiatric assessment of working ability, SDS and RTW-SE scores both predicted return to work within one year. Return to work was reported in 27% of the sample. Less than 6 months off work and having employment at baseline were the strongest associated background factors regarding being at work at the time of the one-year follow-up.

Increased self-reported function (lower mean SDS scores) predicted successful return to work, as expected. The association with better return to work outcomes was found with each SDS subscale: work, home and social life. According to our hypothesis, higher return to work self-efficacy (higher RTW-SE scores) also predicted return to work. SDS and RTW-SE scores both seem to be equally good predictors of RTW. In the adjusted logistic regression model, the statistical significance of these predictive values remained clear. A new finding in our study is that the RTW-SE score is not only a good predictor in patients on sick leave due to common mental disorders, but is also a good predictor in a more severely affected population and an unemployed population. In the ROC analysis of SDS and RTW-SE, the accuracy of both tests was fair (AUC between 0.7 and 0.8). The higher AUC for SDS indicates that SDS is more accurate than RTW-SE in predicting RTW, but the difference is not significant.

Surprisingly, the diagnostic severity did not predict return to work. Despite more severe psychiatric morbidity and lower objective functioning among psychosis patients, their RTW prognosis was not significantly worse than that of patients with mood disorders. This is probably explained by the more negative self-expectations among depressive patients, according to Beck´s cognitive triad (20).

In the most common forms of mental illness, such as depressive and anxiety disorders, patients typically underestimate themselves. These attitudes may persist despite alleviation of other symptoms. Therefore, placing an emphasis on positive questionnaire responses, which highlight the remaining functional capacity or self-efficacy instead of listing symptoms, may help patients in believing in their ability to work. A key finding of the present study is that positive personal psychological resources and work itself are important for returning to or staying at work. A positive psychological framework – including concepts of well-being, positive emotions, self-determination and resilience – is essential to strengthen and broaden psychiatric rehabilitation and recovery in thought and practice (21).

New clinical research evidence shows that psychological interventions should be focused on the specific needs of people in employment and on vocational coping (22, 23). Our previous recent findings among a severe and comorbid psychiatric sample of the same clientele (24) highlight similar earlier findings derived from more general populations: active and early return to work strategies are needed.

For employed first-episode depressive patients, early, vocationally oriented varied psychological intervention seems to be more effective in reducing depressive symptoms than conventional treatment programmes (23). Functional recovery can be substantially accelerated within a regular psychotherapeutic setting through focusing more and earlier on work-related aspects and return to work. In one study, return to work occurred 65 days earlier if cognitive behavioural intervention offered to employees with common mental disorders included a module oriented to work (23).

For return to work in cases of severe mental illness, involvement in vocational support and productive activities may be advantageous early on in the recovery process (25). Being regularly engaged in meaningful and purposeful activity (occupational or vocational) is a key aspect of recovery from mental health and other conditions, and has long been recognized as a central goal of rehabilitation services (26). In one of our previous studies (24), we concluded that RTW intervention is most successful when started before sick leave has extended to six months and coordinated by occupational care providers with consultative aid from a psychiatrist.

Several studies have concluded that the possible predictors of a longer time until return to work are: age more than 50 years, female gender, supervision support, expectation of time off work for longer than three months, higher educational level, long duration of a depressive episode, presence of comorbid mental or physical disorders, a history of previous sick leave and work disability, severity of mental disorders, unemployment, threat of unemployment, severe work load, long absence from work, lower socioeconomic status and the absence of continuous occupational healthcare services (27-31). Intervention measures should be focused on those predictive factors for return to work that can be influenced.

Improving the employment outcomes of those with common mental disorders is a complex issue. There is no single “one size fits all” solution (32) and a variety of forms of intervention is likely to be needed. In addition, some studies have shown that the effectiveness of intervention is dependent on patient characteristics. For example, Rebergen (33) showed that their intervention worked for those with stress, but not for those with more severe problems such as depression.

Subjective assessment tools concerning functional capacity give valuable information regarding planning the timing and focus of RTW interventions. The ideas and experiences behind a fear of returning to work can be managed when they are recognized, and the psychological resources that contribute to RTW can be better utilized and reinforced when they are identified. Subjective assessment tools can reveal the psychological factors that can be influenced by way of tailored psychosocial interventions.

WEAKNESSES OF THE STUDY

The SDS and RTW-SE questionnaires are subjective and therefore may have been affected by motivations regarding receiving social security benefits at the baseline assessment. The patients in our cohort were selected. They had already undergone psychiatric assessment and a treatment trial, and their work ability had been assessed before, but further investigations were needed. The patients had more severe problems than the usual patients in occupational healthcare. We used a modified scale on the RTW-SE questionnaire with a 7-point Likert scale from 0 to 6 instead of the validated 1 to 6. The 7-point scale gives the patient the possibility to choose a neutral answer (3 on the scale). This does not affect the predictive value of the scale, but our mean values were lower than the corresponding ones in other studies..

CONCLUSIONS

In psychiatric assessment of working ability, subjective evaluation of function and work-related self-efficacy are key elements that predict return to work. They deserve attention in rehabilitation planning. The SDS is suitable for the assessment of subjective functional capacity in three central subdomains, even in a psychiatric population with multiple psychiatric and prolonged or complicated disability aspects. The RTW-SE questionnaire is also a useful tool to use in the same population to assess the ideas, attitudes, experiences and feelings about returning to work. Both tools predict return to work. These two instruments are fast and easy to integrate into the clinical examination assessing work ability. However, further research is needed in validating the SDS and RTW-SE questionnaires with actual work performance tests that are not self-reported. Rehabilitation intervention measures, psychotherapeutic and occupational included, should all aim to improve self-efficacy and function, including the subjective sense of capability.

CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

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ACTIVITY TRACKERS IN SHORT-TERM SELF-MONITORING OF PATIENTS WITH SLEEP DISORDERS: PITFALLS AND BENEFITS

ABSTRACT

Wearable activity trackers are increasingly being used for the self-monitoring of well-being. Self-help devices are popular and there is a growing market for the monitoring of physical activity, sleep and other behaviour. However, evidence of their usefulness in relieving insomnia symptoms is scarce. This randomized clinical intervention study investigated the therapeutic significance of activity trackers among patients with sleep disorders that were referred to clinical sleep consultation. All the patients filled sleep logs for two weeks, while the intervention group also wore activity trackers as wristbands. Insomnia symptoms were significantly reduced in the group wearing activity trackers and their quality of life was significantly increased, whereas there were no significant changes in the control group. Subjective benefits of the activity tracking were reported by a majority of the patients, but a change in health behaviour during activity tracking was reported only by one third of the patients. The benefits were emphasized among those patients whose main problem was sleep related and whose psychiatric comorbidity was milder.

KEY WORDS: ACCELEROMETRY, ANXIETY, DEPRESSION, MENTAL WELL-BEING, MOBILE PHONE, 15D

INTRODUCTION

Insomnia, common with chronic somatic and psychiatric illnesses, is independently associated with poor quality of life (1). Long-term insomnia increases the risk of depression (2) and disability (3, 4). A shortened sleep period is associated with decreased cognitive function (5). Total sleep time and sleep efficiency are reduced among psychiatric patients (6).

Negative self-perception is typical of common mental disorders. Misperception of sleep is a typical feature of insomnia (7) and it is associated with hyperarousal (8). Insomnia with subjective underestimation of sleep is associated with depressive and anxious features (9, 10).

Studies about sleep misperception (8–10) and clinical observations have shown subjective monitoring of sleep by sleep logs may even emphasize the stress and worry about insomnia among psychiatric patients. Sleep log, the established assessment method and therapeutic tool in cognitive behavioural approach, may also have adverse effects (11).

According to cognitive behavioural theory, the focus of attention on sleep, excess worry about the consequences of insomnia, adverse behavioural coping, negative sleep perceptions, associations and conditioning are mechanisms behind the persistence of insomnia (12, 13). These maladaptive cognitive and behavioural patterns are targeted in cognitive behavioural interventions that are prioritized treatments with long-term evidence in insomnia (14).

An example of maladaptive coping is the avoidance of physical activity and an excess of rest in the daytime to compensate for poor sleep. The association between physical inactivity and insomnia symptoms is bidirectional: inactivity seems to predict insomnia symptoms, and vice versa. These associations may, to some extent, be explained by common mental disorders and lowered motivation for exercise due to tiredness (15).

Moderate physical exercise has been shown to have immediate effects on the following night's sleep (16) and regular exercise to have positive effects on stress management, well-being and symptom control in mental disorders (17, 18). Exercise as a sole intervention for insomnia is readily available and cost effective but not universally effective (19). Exercise is implicated in a range of physiological changes, including potential alterations of circadian rhythms. The current literature indicates that moderate amounts of exercise, which can be obtained through a variety of means such as brisk walking and resistance training, are sufficient to improve sleep quality (20).

Wearable activity trackers are increasingly used as self-help devices and are possibly useful because health behaviour improves when it is closely monitored. Sleep tracking devices provide an important opportunity for public health intervention, but research on the accuracy and effects of the various commercially available devices is sparse. However, with more research and technological improvement, self-monitoring devices may have an important role in managing sleep problems in patients with insomnia (19).

Ambulatory activity monitoring and sleep logs can be used as complementary monitoring methods, because there are remarkable discrepancies between objective and subjective assessments of physical activity and diurnal rhythms (21).

In this study we aimed to examine if there was any change in subjective insomnia symptoms and well-being during objective activity monitoring with a self-help device, a commonly used simple activity tracker.

MATERIALS

The study population included outpatients referred to Helsinki University Hospital (HUS), Department of Psychiatry for clinical sleep consultation during 2017. The naturalistic sample consisted of patients with persistent sleep complaints (n=105). Among those, 81 who went through the routine clinical assessment with sleep log were included in the study. The rest (n=24) were excluded, because they were examined in a more restricted manner (by telephone, skype or patient file consultation).

All of the 81 patients who were asked to participate the study gave their informed consent. The study patients were aged between 19 and 68 years, mean 39 years. There were 36 males (44%) and 45 females (56%). Most of the patients (n=53) were referred to sleep consultation by the specialists responsible for their psychiatric treatment, and the rest were referred by general practitioners or by specialists from other fields. The patients from psychiatric outpatient units had several referral diagnoses. Some referrals from general practitioners had no definite diagnosis. The referral diagnoses are listed in *Table 1*.

There were no significant differences between the two groups in gender, age, educational level, working status, diagnoses or baseline symptom scores.

METHODS

The patients were randomized into the intervention group or the control group according to the date and time order of referrals, as they were registered by secretaries. The consultation began by an appointment with a nurse, who collected preliminary information and guided the patients in how to fill in questionnaires and sleep logs, while they also informed the patients about our study and asked for their informed consent. Both groups were asked to fill in sleep logs for two weeks before the medical examination, but the intervention group patients were also offered an activity tracker for the same fortnight. They were given instructions for using the activity tracker. The type of activity tracker was a simple, low-cost version of Polar Loop with activity goal setting and an alarm after prolonged immobility of 55 minutes. There was no heart rate monitoring (22).

The activity tracker is based on accelerometry that records all movements in three dimensions. The wearable activity trackers are not classified as medical devices like the actigraphy monitors that are used in clinical neurophysiological assessments, in sleep research and in clinical care of patients with sleep and circadian rhythm abnormalities.

The wearable activity trackers do, however, roughly estimate the amount of daytime activity, and they imprecisely measure the periods of rest, interpreting the most immobile periods as sleep. They are not adequate for comparison between individuals, but they can monitor changes in diurnal activity and rest of an individual over a course of time. The user can follow the activity data with a mobile phone.

At the beginning, all the patients filled in the same clinical questionnaires that were repeated at the end of the monitoring period of two weeks (*Table 2*). Higher scores in the symptom scales and the quality of life scale reflect more morbidity, thus a decrease of scores refers to a positive clinical change or a relief of symptoms. The scale of SWEMWBS makes an exception, as a higher score reflects a better mental well-being, thus a decrease of score refers to a weakening of mental well-being.

In addition, the intervention group was asked categorical questions about the experienced benefits and adverse effects of the activity trackers, and about the possible behavioural change. Furthermore, free comments were encouraged to obtain qualitative information (*Table 3*).

The quantitative data was processed by SPSS. As our sample was small and some of the variables were not normally distributed, we used nonparametric statistical tests with the Bonferroni correction for the statistical significances of the outcome measures. Wilcoxon test was used to analyse the difference between baseline and follow-up measures, and Mann-Whitney U test to detect the intergroup differences of the changes. For the comparison of baseline characteristics of the two groups, we used chi-squared test for categorized variables, t-test for age and Mann-Whitney U test for outcome variables.

REFERRAL DIAGNOSES

- F31-32 Mood disorders n=36 (44%)
- F51 Non-organic sleep disorders n=35 (43%)
- F40-49 Neurotic, stress-related and somatoform disorders n=16 (20%)
- G47 Organic sleep disorders n=6 (7%)
- F60-69 Personality disorders n=4 (5%)
- F80-98 Developmental neuropsychiatric disorders n=3 (4%)
- F20-29 Psychotic disorders n=2 (2%)

CONSULTATION DIAGNOSES

F51 Non-organic sleep disorders n=46 (57%)

- F51.0 Non-organic insomnia n=35 (43%)
- F51.5 Nightmares n=8 (10%)
- F51.4 Sleep terrors n=6 (7%)
- F51.3 Sleep walking n=2 (2%)
- F51.1 Non-organic hypersomnia n=1 (1%)
- F51.2 Non-organic disorders of sleep-wake schedule n=1 (1%)
- F51.8 Other non-organic sleep disorders n=1 (1%)

G47 Sleep disorders n=39 (48%)

- G47.2 Disorders of the sleep-wake schedule n=19 (23%)
- G47.3 Sleep apnoea n=18 (22%)
- G47.1 Hypersomnias n=1 (1%)
- G47.4 Narcolepsy and cataplexy n=1 (1%)

G25 Other extrapyramidal and movement disorders n=18 (22%)

- G25.8 Restless legs syndrome n=18 (22%)

Table 1. Diagnoses of sleep consultation patients (n=81), both primary and secondary diagnoses reported.

Name of the questionnaire, abbreviation and reference		**Scale**	**Study sample:** Range	Mean	Median	SD
Insomnia severity index ISI	(32)	0-28	8-28	18.4	19.0	5.16
Dysfunctional beliefs and attitudes about sleep DBAS-16	(33)	0-10	2.6-9.1	6.2	6.1	1.56
Overall anxiety severity and impairment scale OASIS	(34)	0-20	0-19	8.8	10.0	5.48
Beck's Depression Inventory BDI	(35)	0-63	0-51	20.3	18.0	12.2
The Short Warwick-Edinburgh Mental Well-being Scale SWEMWBS	(36)	7-35	11-35	21.4	21.0	5.40
Health-related quality of life instrument 15D	(37)	15-75	17-46	30.6	30.0	6.96

Table 2. The questionnaires and their baseline scores (range, mean, median and SD) in the whole sample.

	Significance of change in scores (Wilcoxon test)		**Intergroup difference of the change** (Mann-Whitney U test)
	Activity tracker group	Controls	
ISI	p<0.0005; **p<0.003**	p=0.887	p=0.005; **p=0.030**
DBAS	p=0.743	p=0.666	p=0.857
OASIS	p=0.991	p=0.196	p=0.479
BDI	p=0.007; **p=0.042**	p=0.641	p=0.193
SWEMWBS	p=0.991	p=0.009; **p=0.054**	p=0.078
15D	p=0.020; **p=0.120**	p=0.420	p=0.045; **p=0.270**

Table 3. Results. Comparison of baseline and follow-up scores in both groups (activity tracker wearers and controls) and intergroup comparison of the score changes with the controls. Statistically significant p-values are corrected with the Bonferroni correction (bolded font).

RESULTS

CHANGE OF SYMPTOMS, MENTAL WELL-BEING AND QUALITY OF LIFE

The patients with activity trackers showed a significant reduction of insomnia and depression symptoms as measured by ISI and BDI. The differences remained significant after the Bonferroni correction. Their quality of life as measured by 15D increased significantly, but after the Bonferroni correction the increase was non-significant.

The controls showed no significant changes in any scores except that the mental well-being measured by SWEMWBS was reduced, but the decrease of well-being scores became non-significant after the Bonferroni correction.

When the changes of clinical scores were compared between intervention group and controls, a significant intergroup difference was detected in insomnia symptoms measured by ISI and quality of life measured by 15D, but the latter became non-significant after the Bonferroni correction.

The statistical values are presented in Table 3, and the comparison of changes in scores between the two groups are illustrated in *Figures 1–6*.

THE EXPERIENCES OF THE PATIENTS

Most of the patients with activity trackers (35 out of 38, 92%) responded to the feedback questionnaire. The activity tracker was reported to be useful by a majority of the respondents (22 patients, 62%). It was reported to be harmful by 3 of the patients (9%), and the rest (10 patients, 29%) did not report harm nor benefit. The descriptive comments of the patients are categorized and reported in *Table 4*.

The patients that reported benefit from the activity trackers (n=22) were compared to the rest (n=13) because of the small sample size. The gender made no difference (chi-squared p=0.268). The male to female ratio was 10:12 among those with positive experiences and 7:6 among the others. The mean age was not significantly different between those who experienced benefit and those who did not (t-test p=0.336), although the mean age of the former group was higher (44.8 years) than that of the latter (40.6 years).

The patients, who reported benefit from activity trackers, had more sleep disorders (n=9, 41% vs n=3, 23%) and less mood disorder diagnoses (n=8, 36% vs n=6, 46%) as a main diagnosis, whereas anxiety disorders were as common in both groups (n=5, 23% vs n=3, 23%). Among patients with either non-organic or organic sleep disorders, there were more benefits than among patients without sleep disorder as main diagnosis, but the differences (chi-squared p-values, consequently p=0.088 and p=0.060) were, however, non-significant. Among patients with no benefits, there was one psychotic main diagnosis, substance abuse disorder and generally more psychiatric comorbidity.

Figure 1.
Change in ISI scores, comparison between the groups. Decrease of scores (a change below zero) reflects relief of symptoms. There is more symptom relief in the intervention group (p=0.005), even after the Bonferroni correction (p=0.030).

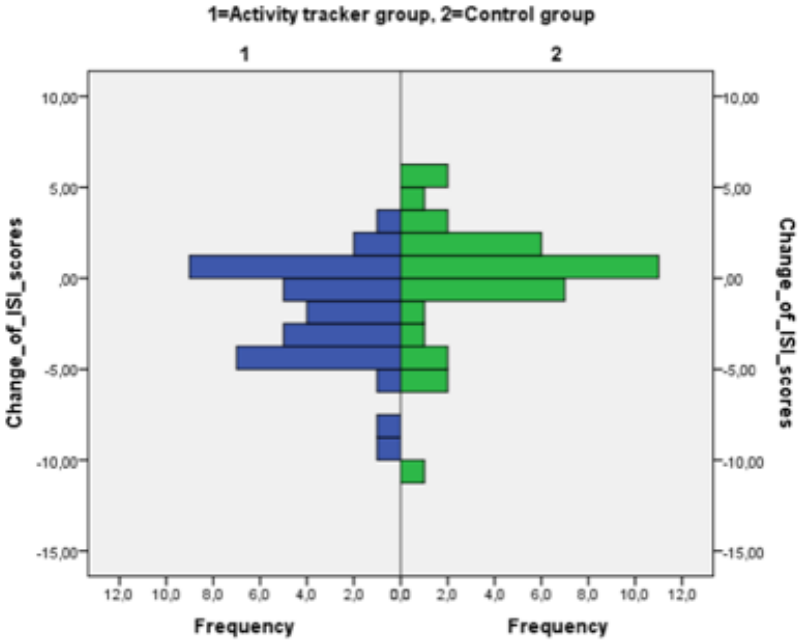


Figure 2.
Change in DBAS scores, comparison between the groups. Decrease of scores (a change below zero) reflects relief of symptoms. No significant difference between the groups was detected (p=0.857).

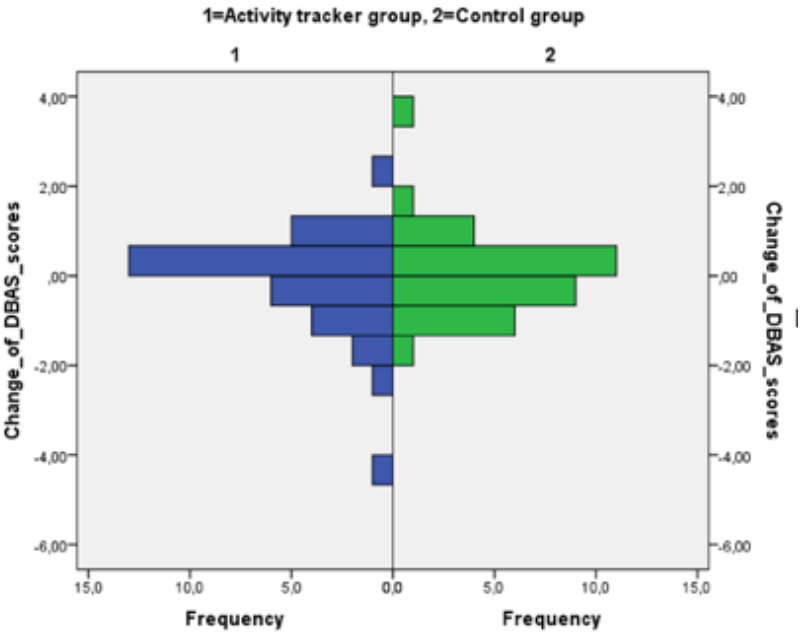


Figure 3.
Change in OASIS scores, comparison between the groups. Decrease of scores (a change below zero) reflects relief of symptoms. No significant difference between the groups was detected (p=0.479).

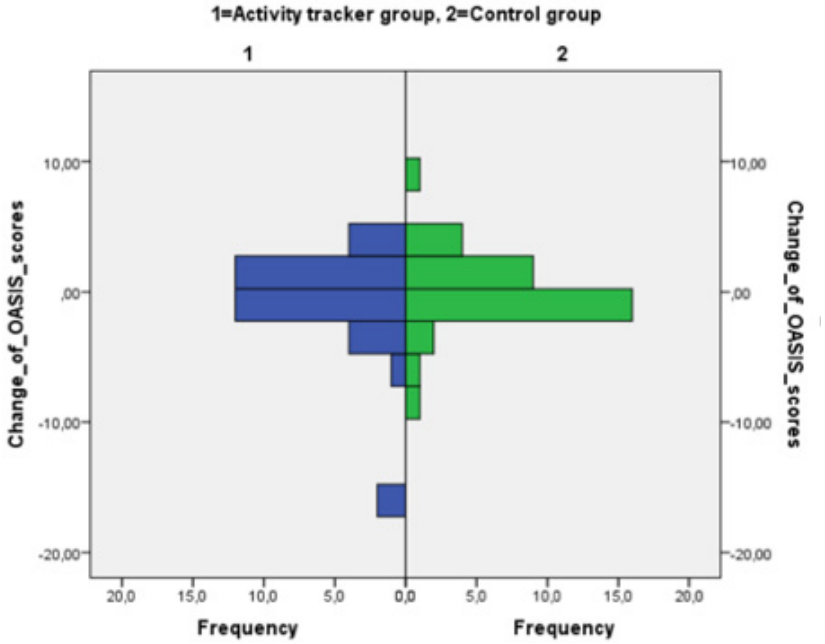


Figure 4.
Change in BDI scores, comparison between the groups. Decrease of scores (a change below zero) reflects relief of symptoms. No significant difference in symptom change between the groups was detected (p=0.193).

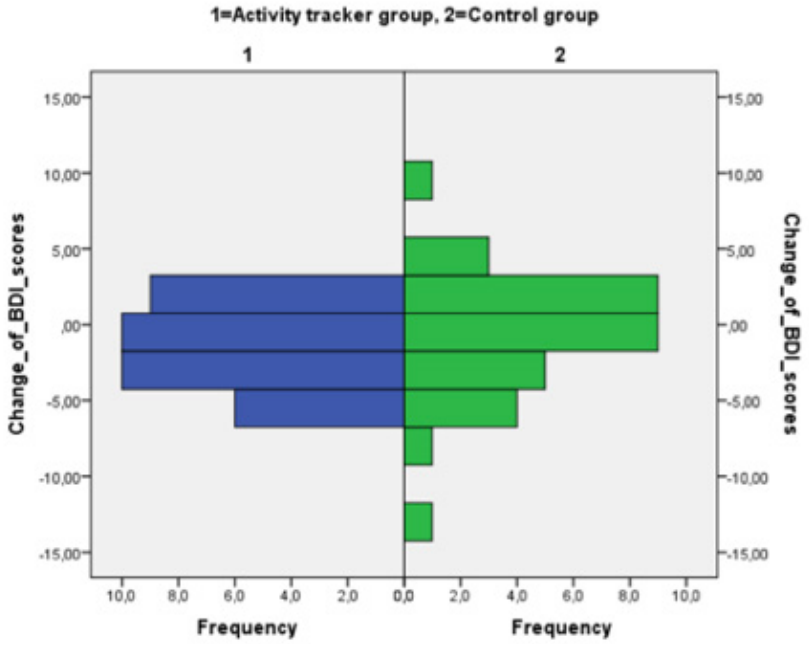


Figure 5.
Change in SWEMWBS scores, comparison between the groups. In contrast to other scales, an increase of scores reflects a positive change, referring to an increase of well-being. No significant difference in symptom change between the groups was detected (p=0.078).

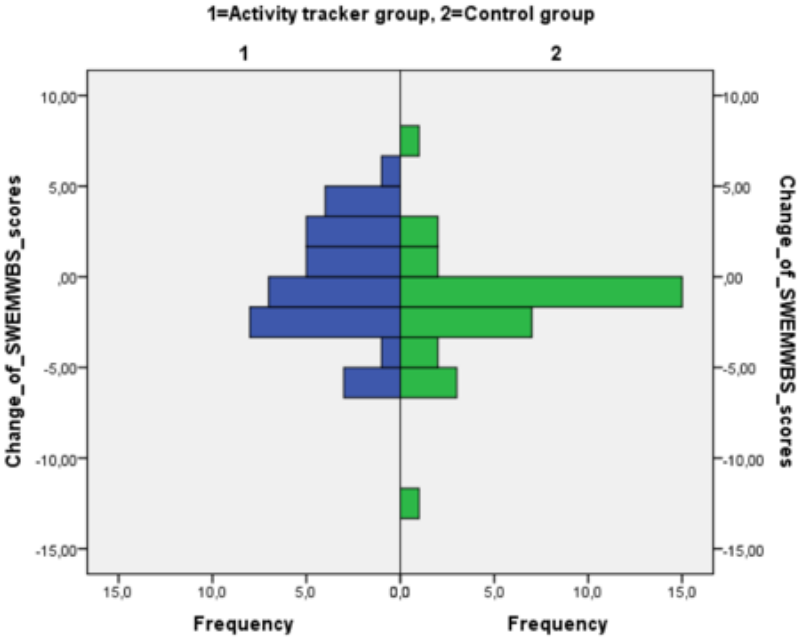
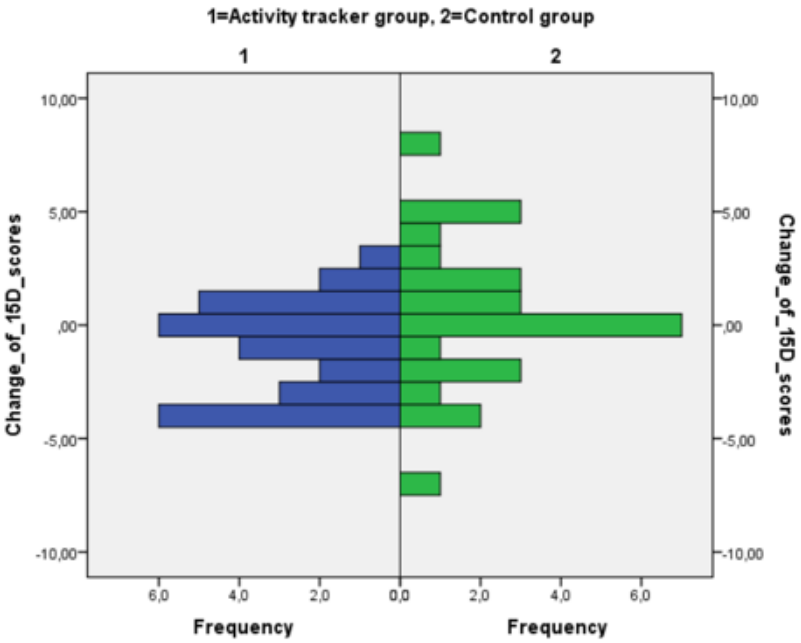


Figure 6.
Change in 15D scores, comparison between the groups. Decrease of scores (a change below zero) reflects amelioration of life quality. The difference between the groups was significant (p=0.045) referring to positive change in life quality in the intervention group, but after the Bonferroni correction the difference was non-significant (p=0.270).



A. For those, who reported benefits: What kind of benefits did you experience?

- Informs about one's activity (9 comments)
- Motivates to physical activity (6)
- Informs about one's rest or sleep (6)
- Gives objective information (3)
- Interesting, new experience (2)
- Informs about one's diurnal rhythms (1)
- Weight loss (1)

B. For those, who reported adverse effects: What kind of adverse effects did you experience?

- Stress (2)
- Mechanical disturbance (2)
- Motivated to exercise too much (1)

C. For those, who reported to have obtained new information: What kind of new information did you get?

Amount of activity (15)

- Surprised by one's low activity (3) / high activity (1)
- Recognition of the need to move more (2)
- How much and what kind of exercise is needed (1)

Sleep amount and quality (9)

- Better than expected (2)

Table 4. Free responses of the patients to questions about activity trackers.

DISCUSSION

In this study, the insomnia symptoms of clinical sleep consultation patients were significantly relieved while wearing activity trackers. The comparison of the change with controls demonstrates a specific effect with the activity trackers, which cannot be explained by the simultaneous use of sleep logs and initial nurse interviews, which were similar procedures for both groups.

Most of the patients wearing activity trackers (62%) reported benefits, while 29% reported no effects and 9% reported adverse effects. The most frequent subjective benefits were the knowledge about activity and the encouragement to increase activity. Follow-up information about sleep was also found useful. The negative experiences (9%) were related to increased stress and mechanical disturbance, including skin irritation.

Spontaneous comments of the patients included critiques about the limitations of the activity trackers: the underestimation of the activity counts in certain activities (swimming and cycling) and the inability to accurately differentiate between sleep and wake. Many patients, however, were enthusiastic about the activity trackers: five of them reported having bought their own activity tracker to continue with, and three of the patients asked to borrow an activity tracker for some extra time after their follow-up had ended. They were given the activity trackers for an extra month outside of the study, because there were enough trackers available. According to spontaneous comments after the study, one month, at least, would be more suitable for attaining behavioural changes.

The relatively short follow-up period of two weeks is a clear limitation of the study. The length was defined by the clinical process to avoid any delay in consultation: before medical examination at the doctor's appointment, all the sleep consultation patients filled in sleep logs for two weeks to obtain current information about their sleeping habits, sleep rhythm, and subjective perceptions about the quantity and quality of sleep. Thus, the activity tracker period was integrated with the sleep log follow-up for those randomized to the intervention group to keep the clinical process standardized.

Another important limitation of this naturalistic study is that the small sample size weakens the statistical power of our results. The small sample size does not allow exclusion other possible associations that were not detected here and the diagnosis-related differences in patient reported benefits could not be statistically confirmed due to the sample size.

Limitations of the study also include the lack of objective measurements. The subjective distress of insomnia, however, is one of the core phenomena in functional insomnia, thus measuring subjective change is adequate. The objective change in sleep and amount of activity would have been interesting to measure with clinical actigraphy, but then there would also have to be wristband devices for controls, and even two wristband devices for the intervention group patients. This would have been another type of study setting, less naturalistic, but it would have allowed comparison of the sleep reports between clinical actigraphy monitors and wearable activity trackers, in addition to offering objective information about the changes in diurnal activity.

In this study sample, comorbid psychiatric diagnoses were common, reducing the generalizability of the results. The results might have been better in non-psychiatric samples, because motivational problems and persisting maladaptive health behaviour are common in mental disorders. In this sample, those patients with more depressive symptoms and more serious psychiatric disorders reported less benefit from the activity trackers. After the study follow-up, those patients who experienced obstacles (like pain, fatigue, anxiety) for increasing physical activity were referred to a physiotherapist for psychophysiological therapy.

According to later clinical follow-up and patient feedback, it seemed that the patients, who could not benefit from the activity trackers were, however, able to benefit from some sensitively guided psychophysiological methods to increase body awareness to encourage individually suitable bodily rehearsals. Physiotherapeutic interventions may be needed for insomnia patients with dysfunctional body awareness, typical of somatoform and eating disorders, also sometimes present in anxiety and depressive disorders.

Most of the study patients were diagnosed with non-organic sleep disorders and the most common diagnosis was insomnia. There were also parasomnias, organic sleep disorders and psychiatric disorders as main diagnoses, but even among them functional insomnia symptoms were common. Cognitive behavioural therapy (CBT) is the primary evidence-based treatment for insomnia, abbreviated as CBT-i (14). CBT-i is safe and effective in the long term (13,14). After the study procedure, all patients with functional insomnia, who were motivated enough, were offered either group or individual CBT. Beyond the study observations, it looks like the activity trackers gave a good start for the behavioural modifications that are elements of CBT. This study did not find out if the response to CBT could be enhanced by activity trackers, used in parallel with the traditional sleep logs.

Morin et al (2004) suggested using sleep hygiene instructions as a starting point in CBT-i (23). Sleep hygiene refers to things about lifestyle that can be changed to improve sleep pattern. Exercise is one of the main lifestyle factors that have effects of sleep. Physically fit people have a better quality of sleep. A good way to promote sleep might be to encourage patients to exercise three times a week for 20-30 minutes and to build up their aerobic fitness level (23).

In addition to the relief of insomnia symptoms, the patients wearing activity trackers also showed a small, but significant reduction of depressive symptoms, which was related to reported increase of physical exercise. The reduction of insomnia symptoms, however, was not related to reported increase of activity. Among the activity tracker patients that gave feedback (n=35), there were 13 who reported increased physical exercise. A small sample size may not find associations and so not allow further conclusions. The subjectively reported change in health behaviour was in line with the change of activity counts.

The increasing use of activity trackers brings great potential for public health (15). Lack of physical activity is a remarkable challenge to well-being for the prevention and treatment of common diseases in society, like diabetes, joint and muscular diseases, hypertension, ischaemic heart disease, sleep apnoea, depression and insomnia. According to a recent clinical study in Finland (24), pedometers, a simple type of activity tracker, seemed to be useful for patients with chronic obstructive pulmonary disease in motivating them to physical exercise. Similarly, self-guided activity monitoring could be increasingly used to motivate patients toward behavioural change and to encourage their own active and responsible role in carrying out and monitoring the changes.

Setting goals and monitoring the progress by self-help devices can motivate some patients for optimal exercise. Yet, some individuals and clinical patient groups have special obstacles related to daytime tiredness and dysfunctional beliefs, which are common in insomnia. Patients with depression have even more challenges for behavioural change, including the lack of motivation, reward, initiative and energy. In our study, untreated depression presumably formed some obstacle for experiencing the benefits of activity tracking. The activity trackers were most useful for those patients whose insomnia was the main clinical problem, and other psychiatric symptoms were adequately under control.

Established behaviour change techniques include goal setting, feedback, rewards, social support, coaching, identifying barriers/problem solving and action planning (25-29). Increasing physical activity and subsequent weight loss are more successful with interventions that include established behaviour change techniques than those without. Specifically, self-regulatory behaviour change techniques such as goal setting, self-monitoring and social support are associated with better outcomes (30). Most of the commercially available activity trackers (Jawbone UP24, Nike Fuelband, Polar Loop, Misfit Shine, Withings Pulse, Fitbit Zip and Spark) are equipped with goal setting, feedback, rewards, self-monitoring and social support (29).

There are, however, other strategies not typically included in fitness technologies that are promising for engaging inactive vulnerable populations. These include action planning, restructuring negative attitudes, enhancing environmental conditions, and identifying other barriers to regular physical activity (31). In our study sample, there were patients that would probably have needed these more advanced technologies for behavioural change and more favourable clinical outcomes.

CONCLUSIONS

Wearable activity trackers help to relieve insomnia symptoms according to this naturalistic pilot study. They can be used as a complementary self-help method to offer the patient some follow-up data about diurnal activity and rest, and to motivate insomnia patients to physical exercise.

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