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ORIGINAL ARTICLE

Physical Activity, Psychological Distress, Perceived Stress, and Sleep Quality in People with Schizophrenia and Depression: A Descriptive Cross-Sectional Study

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Background: People with mental illness often experienced sleep disturbances. Physical activity and psychological factors may be associated with sleep quality among people with mental illness. **Aim:** The purpose of this study was to assess the association between physical activity (PA), psychological distress, perceived stress, and sleep quality in people with mental illness. **Methods:** Sixty-seven people with schizophrenia, major depressive disorder, and dysthymia were enrolled in the study group. All participants completed the International PA Questionnaire, Kessler psychological distress Scale, the Perceived Stress Scale, and the Pittsburgh Sleep Quality Index (PSQI). **Results:** The results revealed that moderate metabolic equivalent task (MET)-minutes/week (min/wk) and psychological distress accounted for 39% of the variance in subjective sleep quality. Walking MET-min/wk and psychological distress accounted for 24% of the variance in the use of sleep medication. Vigorous MET-min/wk, psychological distress, and perceived stress accounted for 42% of the variance in daytime dysfunction over the previous month. Psychological distress was a significant related factor for sleep duration (adjusted $R^2 = 0.20$) and sleep disturbances (adjusted $R^2 = 0.33$), respectively. A majority of the participants ($n = 58$, 87%) used sleep medication and most (91%) of them had PSQI ≥5, which was suggestive of sleep problems. **Conclusion:** Our results indicated that PA, psychological distress, and perceived stress could have impact on different aspects of sleep quality. More research is needed to explore the association between these variables on sleep quality in people with mental illness.

Key words: Physical activity, psychological distress, perceived stress, sleep quality, mental illness, schizophrenia, depression

INTRODUCTION

People with psychiatric disorders, most notably depressive episode, are more likely to complain about sleep disturbances.[1-3] In addition, sleep problems are also a common complaint in people with schizophrenia and could worsen psychotic symptoms leading to the interference of treatment and rehabilitation.[4,5] Previous studies have shown that people with poor sleep are less likely to meet the standard requirements of physical activity (PA) or exercise in the military or general population.[6,7] Healthy people who engage in higher levels of PA and/or exercise report better sleep quality compared with peers who are sedentary.[8,9] People with insomnia who participate in physical activities show significantly reduced insomnia symptoms and lower depressive and anxiety scores compared to those who are physically inactive.[10] A recent meta-analysis reported that exercise had a significant impact on the sleep quality of individuals with mental illness.[11] Overall, sleep problems have been found to be negatively associated with PA in the general population.[10] Therefore, maintaining an adequate level of PA is a major contributor to the reduction of sleep problems. Although numerous studies have investigated the associations between PA and sleep among the general public,[12,13] little is known about the relationship between sleep quality and PA, especially in individuals with schizophrenia and depressive disorders.

People with mental illness reported lower levels in both high and low intensities of PA compared with the general population.[14-17] People with schizophrenia are more sedentary

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than the general population and only about 25% of them adhere to the recommended 150 min of PA per week.[18-20] Costa *et al*.[21] indicated that sleep quality was positively associated with the duration of moderate and total PA in schizophrenia (including inpatients). The results by Lalande *et al*.[22] showed that eight people with schizophrenia who engaged in strength training and cardiovascular fitness exercises reported an improvement in sleep and felt less depressed. People with nonremitted major depressive disorder who received exercise augmentation reported improved sleep quality.[23] Sleep disturbance is a major problem in people with schizophrenia,[24] as well as those with major depressive disorder and dysthymia (a continuous long-term chronic form of depression in which sleep disturbance is a symptom of the disorder). However, previous studies recruited participants who were inpatients or who were not in the remitted state, which may yield instable results. Research is needed to evaluate the associations between PA and sleep quality in stably medicated outpatients. When patients are in the acute state or not in the remitted state, they would have more sleep complaints and were less likely to participate in more physical activities due to their symptoms. In addition, many patients will need time to adapt to changes in medication dosage or to other types of medication, thus causing patients to be less likely to increase in PA.

Felder *et al*.[25] found that poor sleep quality was associated with worsening psychological distress among pregnant women. Seun-Fadipe and Mosaku[26] indicated that psychological distress was also significantly associated with poor sleep quality in university students. The results by Rezaei *et al*.[27] also found that poor sleep quality was associated with psychological symptoms in medical students. Such psychological distress is often viewed as a nonspecific clinical presentation characterized by a constellation of depressive and anxiety symptoms that may fall short of a diagnosis of major depressive disorder but can greatly affect people's social function and daily lives.[28,29] Psychological distress, often experienced among major depressive disorder patients, is correlated with poor lifestyle factors including physical inactivity, alcohol intake, chronic diseases, and greater all-cause and disease-specific mortality.[30,31] Chiu *et al*.[32] found that substantial health-care costs were significantly higher in people with psychological distress and major depressive disorder compared to those without psychological distress and major depressive disorder. These symptoms were comorbid complaints in people with mental disorder[33] and may continuously influence their sleep quality.

Stress was the most studied psychosocial precipitant that influenced an individual's sleep-related complaints and mental health.[34-36] Previous findings have shown that increased perceived stress was strongly associated with sleep disturbances.[37,38] However, the findings of these studies were obtained through university students or the general population; thus, the perceived stress level and sleep quality in people with mental illness remain unclear.

The main purpose of the study was to explore (1) the associations of PA, psychological distress, perceived stress, and sleep quality in people with mental illness and (2) the differences between PA, psychological distress, perceived stress, and sleep quality in people with schizophrenia and depressive disorder (major depressive disorder and dysthymia).

MATERIALS AND METHODS

Participants and procedures

The study protocol was reviewed and approved by the Kaohsiung Armed Forces General Hospital Institutional Review Board and gained approval date from February 2, 2018, to December 31, 2018 (No. KAFGH106-044). Prior to receiving assessments, written informed consent was obtained from all participants. All participants of the study met the following criteria: (1) a diagnosis of schizophrenia, major depressive disorder, and dysthymia was based on the Diagnostic and Statistical Manual of Mental Disorders-5 criteria[39] made by senior psychiatrists in the Department of Psychiatry, Zuoying Branch of Kaohsiung Armed Forces General Hospital. (2) All patients were stably adhered on medical regimen without changes in the dosage of medications within the previous month and had no acute hospitalizations. Patients were excluded if they: (a) had acute psychotic symptoms or acute depressive episode, intellectual disabilities, and (b) had neurological disorders in the preceding 6 months. We approached 80 patients by telephone to request their participation in the study. Six participants who had acute psychotic and depressive symptoms were excluded and seven participants refused to enter this study. Sixty-seven outpatients with mental illness (31 males, 36 females; including 46 people with schizophrenia, 16 major depressive disorder, and 5 dysthymia) were enrolled in the study. All participants were on stable doses of medication and in healthy physical condition (schizophrenia participants received atypical antipsychotic medication and major depressive disorder and dysthymia participants received antidepressant medication).

Measures

International Physical Activity Questionnaire

PA was developed by an International Consensus Group in 1997 and 1998. The reliability and validity of the International Physical Activity Questionnaire (IPAQ) were evaluated across 12 countries in 2000, and results showed that the IPAQ had good reliability and validity.[40,41] The IPAQ-long form was used which included four domains of PA during the past 7 days: work, transportation, housework, and leisure. The IPAQ can be self-reported or administered during in-person or telephone interviews. In this study, we allowed participants to provide

self-reports on the IPAQ. The questionnaire provided specific scores for walking, moderate-intensity, and vigorous-intensity activity within four domains of work, transportation, housework, and leisure, and total scores were summated from the duration (in minutes) and frequency (days) for these types of activities in the four domains. The amount of PA was standardized according to the metabolic equivalent task (MET) minutes per week (MET-min/wk). Total PA (total MET-min/wk) was calculated as a sum of vigorous PA, moderate PA, and walking MET-min/wk scores. PA levels were also classified into three categories: low active, moderate active, and high active groups according to the IPAQ scoring protocol. The questionnaire also includes two questions about the time spent on sitting as an indicator of sedentary activity. The Taiwanese version of IPAQ was used in this study (information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se).

Kessler Psychological Distress Scale

The Kessler Psychological Distress Scale (K10) scale is a 10-item questionnaire measuring the frequency of psychological distress (experience in the depressed or anxious state) within the past month. Respondents were asked to report each experience they had over the past month on a five-point scale (none of the time, a little of the time, some of the time, most of the time, and all of the time). K10 scores ranged from 10 to 40, with higher scores indicating higher levels of psychological distress.[42,43] The Kessler 10 (K10) has been translated into 27 languages, including the Chinese traditional version.[44]

The Perceived Stress Scale

The Perceived Stress Scale (PSS) is a 14-item questionnaire that measures certain experiences of perceived stress in the preceding month. Respondents were asked to assess each question rated on a five-point scale (from 0 = never to 4 = very often). Total scores were calculated after reversing positive items' scores and then summed up. The scores ranged from 0 to 56, and higher scores indicated greater stress. The Chinese version of PSS was used in this study.[45]

The Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire that measures sleep quality and disturbances in the last month. It includes seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component was scored from 0 to 3, and the seven components were summed to obtain a total PSQI score (possible range from 0 to 21). A global score of above 5 indicates poor quality of sleep.[46] The Chinese version of PSQI was used in this study.[47]

Statistical analysis

All statistical analyses were performed using SPSS 22.0 software (Command Syntax Reference. Chicago, Illinois: SPSS Inc.). Mean standard deviation (SD) and percentages were calculated. For all significant effects, an alpha level of 0.05 was applied. We performed a Pearson correlation among PA, psychological distress, perceived stress, and sleep quality. Stepwise linear regression analyses were performed to explore the relative contribution of each significant variable between PA, psychological distress, and perceived stress as independent variables and sleep quality as dependent variables. The Student's *t*-test was used to examine group differences in parametric variables. Given the present sample size ($n = 46$ in schizophrenia group and $n = 21$ in depression group), the study had a 50% power or higher to detect an effect size of Cohen's d = 0.5–1.5 at $P < 0.05$ uncorrected.

RESULTS

Sample description

The demographic characteristics and clinical measures of the 67 patients are presented in Table 1. The mean age of the participants was 43.2 years (SD = 12.2). Most participants were single (69%), unemployed (84%), and had an education level of senior high school (mean = 12.4, SD = 2.8). The onset of illness and the duration of illness were at the age of 29.2 (SD = 12.2) and 13.7 years (SD = 8.5), respectively. Only 11 of the participants were currently employed and worked as blue-collar workers. Fifty-eight (87%) participants used sleep medication [data not shown in Table 1]. A majority of (91%) participants had PSQI ≥5, which was suggestive of sleep problems.

Table 2 displays the time spent and the amount of each type of PA participants engaged in during 1 week. Only 14 (21%) of the participants met the mental health-recommended PA guideline of 150 min of at least moderate-intensity PA per week, proposed by the International Organization of Physical Therapists. Fifteen percent reported to have reached 37.6 min of vigorous PA/per week. Twenty-one percent reported that they reached 335.2 min of total PA/per week. The mean duration of sedentary behavior was 388.14 min/day (6.4 h) and 59% reported 388.14 min of sedentary behavior daily.

Difference in clinical measures of the depressive and schizophrenia groups

The depressive disorder group had lower levels of moderate and total PA and higher scores in psychological distress and perceived stress than the schizophrenia group ($P < 0.05$; $P < 0.001$). Although the depressive disorder group had a lower level of walking and vigorous PA than the schizophrenia group, this difference did not reach significance. The depressive disorder group had more complaints in total PSQI ($P < 0.001$) [Table 3].

Table 1: Demographic characteristics and clinical characteristics (n=67)

	Mean±SD/n (%)
Age (years)	43.0±12.2
Education (years)	12.4±2.8
Onset of illness (average age)	29.2±12.2
Illness duration (years)	13.7±8.5
Gender	
Male	31 (47)
Female	36 (53)
Occupation	
Currently unemployed	56 (84)
Currently employed	11 (16)
Marital status	
Single	46 (69)
Married	16 (24)
Widowed/divorced	5 (7)
K10	21.2±9.2
The PSS	33.2±10.1
The PSQI	11.0±4.3
Subjective sleep quality	1.5±0.9
Sleep latency	1.8±0.9
Sleep duration	1.0±1.1
Habitual sleep efficiency	0.2±0.5
Sleep disturbances	2.2±0.7
Use of sleep medication	2.3±1.0
Daytime dysfunction over the last month	1.7±0.9
Poor sleepers (total PSQI ≥5)	61 (91)

PSQI=Pittsburgh Sleep Quality Index; PSS=Perceived Stress Scale; K10=Kessler Psychological Distress Scale; SD=Standard deviation

Table 2: Characteristics of International Physical Activity Questionnaire (n=67)

	Time (min/week)	MET min/week	n (%)
Walking physical activity	136.4±234.4	450.3±773.7	17 (26)
Moderate physical activity	161.2±335.0	645.0±1340.1	14 (21)
Vigorous physical activity	37.6±130.8	301.3±1046.6	10 (15)
Total physical activity	335.2±700.2	1396.6±3160.4	14 (21)
Sedentary behavior (min/day)	388.14±138.91		40 (59)

MET-min/week=Metabolic equivalent task-minutes per week

Correlations of physical activity, psychological distress, perceived stress, and sleep quality

Walking MET-min/wk was negatively correlated with the use of sleep medication (r = −0.275). Moderate MET-min/wk was negatively associated with subjective sleep quality (r = −0.241). Vigorous MET-min/wk and total PA MET-min/wk were negatively correlated with daytime dysfunction over the last month, respectively (r = −0.290, r = −0.270). Psychological distress and perceived stress were positively correlated with subjective sleep quality, sleep duration, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month, respectively (r = 0.632, r = 0.516; r = 0.465, r = 0.384; r = 0.585, r = 0.513; r = 0.366, r = 0.373; r = 0.618, r = 0.650) [Table 4].

Regression analysis

As summarized in Table 4, moderate MET-min/wk and psychological distress emerged to contribute significantly as related factors of subjects' subjective sleep quality (adjusted R^2 = 0.39, P < 0.001). Walking MET-min/wk and psychological distress emerged as significant contributors to the use of sleep medication (adjusted R^2 = 0.24, P < 0.001). Vigorous MET-min/wk, psychological distress, and perceived stress were significant related factors for daytime dysfunction over the last month (adjusted R^2 = 0.42, P < 0.05). Psychological distress emerged as a significant contributor to sleep duration (adjusted R^2 = 0.20, P < 0.001) and sleep disturbances (adjusted R^2 = 0.33, P < 0.001), respectively. Table 5 presents the details of beta-weights of each contributing variable.

DISCUSSION

This was the first study to investigate PA, psychological distress, perceived stress, and sleep quality among individuals with mental illness. We found that different types of PA were negatively correlated with PSQI subdomains, including subjective quality, use of sleep medication, and daytime dysfunction over the previous month. These results were consistent with previous studies that people with mental illness who engaged in more PA reported improved sleep quality.[21-23]

The depressive disorder group had significantly lower moderate MET-min/wk and total PA MET-min/wk than the schizophrenia group. Although the depressive disorder group had lower levels of walking and vigorous PA than the schizophrenia group, this difference did not reach significance. The depressive disorder group also had higher levels of psychological distress, perceived stress, and sleep disturbances than the schizophrenia group. A probable reason may be related to the core symptoms of major depressive disorder and dysthymia in which there is a presence of depressed mood, loss of interest or pleasure, and sleep disturbances.[48] Although our participants of this study were stable medicated outpatients, people with major depressive disorder and dysthymia may still experience more distress, higher perceived stress, and more sleep disturbances than those with schizophrenia. In accordance, the depressive disorder group may lack the motivation to spend more time on PA because of these remitted depressive symptoms.

Table 3: Description of clinical measures of the two groups

	Mean±SD		*P*	Cohen's D
	Schizophrenia group (*n*=46)	MDD and dysthymia group (*n*=21)		
Walking MET-min/week	495.2±859.0	352.1±446.9	0.475	0.20
Moderate MET-min/week	829.9±1567.7	240.0±381.2	0.020*	0.51
Vigorous MET-min/week	408.0±1247.8	67.6±167.6	0.076	0.38
Total physical activity MET-min/week	1726.3±2880.8	659.7±761.0	0.023*	0.50
Sedentary behavior (min/day)	374.72±108.25	417.55±189.72	0.245	0.27
K10	17.8±8.3	28.6±6.5	<0.001***	1.44
The PSS	30.1±9.7	39.9±7.8	<0.001***	1.11
Total PSQI	9.4±3.9	14.5±2.5	<0.001***	1.55

*P<0.05, ***P<0.001. MET-min/week=Metabolic equivalent task-minutes per week; PSQI=Pittsburgh Sleep Quality Index; MDD=Major depressive disorder; PSS=Perceived Stress Scale; K10=Kessler Psychological Distress Scale; SD=Standard deviation

Table 4: Correlations of physical activity, psychological distress, perceived stress, and sleep quality of participants (*n*=67)

Variables	Subjective sleep quality	Sleep latency	Sleep duration	Habitual sleep efficiency	Sleep disturbances	Use of sleep medication	Daytime dysfunction over the last month
Walking MET-min/week	0.016	0.084	−0.064	−0.122	−0.015	−0.275*	−0.147
Moderate MET-min/week	−0.241*	−0.094	−0.170	−0.092	−0.063	−0.014	0.187
Vigorous MET-min/week	−0.139	−0.128	−0.111	−0.132	−0.191	0.116	−0.290*
Total physical activity MET-min/week	−0.185	−0.077	−0.159	−0.142	−0.118	0.128	−0.270*
Sedentary behavior (min/day)	0.117	−0.023	0.044	−0.078	0.122	−0.063	0.021
Psychological distress	0.632**	0.233	0.465**	0.093	0.585**	0.366**	0.618**
Perceived stress	0.516**	0.205	0.384**	0.077	0.513**	0.373*	0.650**

*P<0.05, **P<0.01. MET-min/week=Metabolic equivalent task-minutes per week

Table 5: Stepwise regression predicting subdomains of Pittsburgh Sleep Quality Index from clinical measures (*n*=67)

Dependent variables	Independent variables	*B*	*t*	*P*
Subjective sleep quality	Moderate MET-min/week	−0.24	−1.99	0.05*
	Psychological distress	0.60	6.26	<0.001***
	Overall model: R^2=0.41, Adjusted R^2=0.39			
Sleep duration	Psychological distress	0.46	4.23	<0.001***
	Overall model: R^2=0.21, Adjusted R^2=0.20			
Sleep disturbances	Psychological distress	0.58	5.48	<0.001***
	Overall model: R^2=0.34, Adjusted R^2=0.33			
Use of sleep medication	Walking MET-min/week	−0.27	2.30	0.02*
	Psychological distress	0.44	4.08	<0.001***
	Overall model: R^2=0.26, Adjusted R^2=0.24			
Daytime dysfunction over the last month	Vigorous MET-min/week	−0.306	−2.492	0.01*
	Psychological distress	0.58	5.82	<0.001***
	Perceived stress	0.42	2.34	0.02*
	Overall model: R^2=0.44, Adjusted R^2=0.42			

*P<0.05, ***P<0.001. MET-min/wk=Metabolic equivalent task-minutes per week; PSQI=Pittsburgh Sleep Quality Index

Ruminative response is defined as self-focused thoughts that view possible causes and consequences to be depressive and negative.[49] Individuals with depression are likely to perceive more stress because of ruminative response compared to

the schizophrenia group. Higher levels of rumination have been found to predict more severe depressive symptoms in depressed people as well as the onset of depressive symptoms in nondepressed people.[50,51] The depressed group may feel that ruminative responses may inhibit the motivation to improve sleep quality through PA or exercise. Finally, due to the relative small sample size in the depression group, the clinical results of the comparison between the schizophrenia group and the depression group should be seen as preliminary and a larger sample is needed to confirm these comparisons.

Our results also showed that psychological distress influenced sleep subjective quality, sleep duration and sleep disturbances, use of sleep medication, and daytime dysfunction over the previous month. These findings were in accordance with studies on the general population that psychological distress interfered with sleep quality.[25-27] Higher perceived stress in this study was found to be associated with daytime dysfunction over the past month, which was consistent with previous studies.[37,38] Several studies showed the overreaction of the cerebral immune system (increased microglia or macrophage activities) in the brains of depressed suicides.[52,53] Therefore, increasing PA can have a positive biological impact on the symptoms of depression.

In the present study, only 14 (21%) of our participants met the public health-recommended PA guideline of having 150 min of at least moderate-intensity PA per week. Similarly, the results by Faulkner *et al*.[20] showed that only a minority of people with schizophrenia participated in 150 min of PA per week. PA has been recommended for the improvement of sleep quality in the general population.[54,55] Specific components of sleep are enhanced by regular PA and have beneficial effects on sleep quality. Professional staff could offer psycho-education to allow patients to understand the benefits of PA on sleep improvement. Previous studies demonstrated that PA may improve neuropsychological performance and subjective sleep quality in older healthy adults.[56] Exercise is significantly associated with decreased nonrapid eye movement (REM) Stage N1 (very light sleep) and with increased REM sleep, sleep continuity, and sleep efficiency which contributes to the effect of PA on sleep.[57]

Most of our participants (87%) received sleep medication and 91% of them had PSQI ≥5, which was suggestive of sleep problems. Although these participants received sleep medication, they still experienced more sleep disturbances. In addition to hypnotic medication, they may require a constellation of strategies involving proper sleep habits and lifestyle management, and cognitive-behavioral interventions to improve sleep quality.

This study has some methodological limitations. First, people with mental illness may experience difficulties in properly identifying the frequency, duration, quality of PA, and sleep. Thus, self-reported physical and sleep quality activity may hinder how participants report their experiences. Second, this study included patients with stable symptoms and chronic illnesses. Therefore, careful attention is needed to the interpretation of our findings toward the population with schizophrenia, major depressive disorder, and dysthymia. Third, this study was a cross-sectional study, which may not yield the causal relationships between variables. Thus, gaining a longitudinal, larger sample and healthy participants as control groups may allow for investigators to probe at the association between PA, psychological distress, perceived stress, and sleep quality. In addition, participants received regular psychotropic medications in this study which may have various side effects that can impact sleep quality.[58]

Despite the current limitations, the study provides preliminary data regarding PA levels, psychological distress, perceived stress, and sleep quality in people with mental illness. Different types of PA, psychological distress, and perceived stress were associated with good sleep quality in people with mental illness. Practitioners could offer psycho-education programs and behavioral sleep interventions, including an active lifestyle and behavior strategies for sleep quality (e.g., regular waking and habit and sleep times).[21] In addition, engaging in a biweekly physical exercise program (strength training and cardiovascular fitness exercise indoors) could also reduce sleep problems.[22]

CONCLUSION

Physical activity, psychological distress, and perceived stress could have impact on different aspects of sleep quality.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guarantee.

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Conflicts of interest

There are no conflicts of interest.

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