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Utility of self-reported sleep disturbances as a marker for major depressive disorder (MDD): Findings from the World Mental Health Japan Survey 2002–2006

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Abstract

Although major depressive disorder (MDD) is a serious common disease, many depressive patients attend primary care complaining sleep disturbances and remain undiagnosed. The purpose of this study was to investigate the utility of self-reported sleep disturbances as a marker for MDD. This study investigated the association between 12-month prevalence of self-reported sleep disturbances and MDD using data from a cross-sectional survey in Japan. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the area under the receiver operating characteristic curve (AUC) of self-reported sleep disturbances as a marker for MDD were 58.9%, 73.4%, 6.9%, 98.1%, and 0.66, respectively. Self-reported sleep disturbances showed highest utility for the youngest group. Among four types of sleep disturbances, problem of daytime sleepiness was most useful as a marker for MDD. Combined with at least moderate role impairment, self-reported sleep disturbances became more informative with higher specificity (99.6%) and PPV (80.0%) as a marker for MDD. Self-reported sleep disturbances cannot be a marker for MDD in isolation. Comorbid role impairment increases probability of MDD. Clinicians should be cautious about young people who have sleep disturbances. Daytime sleepiness should be included in the question asking about sleep disturbances.

Keywords

sleep disturbance; major depression; diagnostic tool

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Contributions

The first author made contributions to literature review, data analysis, and writing up of this paper. The second author made contribution to design of this study, data analysis, and revision of this paper. World Mental Health Japan Survey Group contributed to this study in terms of design of this study and data collection.

We declare that there is no conflict of interests.

1. Introduction

1.1 Background

Major depressive disorder (MDD) is a common disorder and a significant public health issue. The median 12-month prevalence of MDD in 42 studies around countries was reported to be 5.3% by a recent review (Eaton et al., 2008). In addition, depressive disorders cause a significant negative impact on daily functioning (WHO, 2005). World Health Organization (WHO) reported unipolar depressive disorder was the fourth leading cause of burden to life among all diseases, accounting for 4.4% of the total Disability Adjusted Life Years (DALYs) in 2000 (WHO, 2001). It was also reported that unipolar depressive disorder will be the leading cause of DALYs by 2020 (Murray and Lopez, 1997). Furthermore, depressive disorder can be fatal: approximately 15% of people with depression commit suicide (Sadock and Sadock, 2007).

Optimal treatment for depressive disorders has been established. The possibility of recovery from MDD within one month approximately doubles with pharmacological treatment (Sadock and Sadock, 2007). However, many depressive patients do not receive optimal treatment (Moller et al., 2003). It was reported that majority of depressive patients were managed not by psychiatrists but by primary care physicians (Kernick, 1997). Many depressive patients seek assistance from general practitioners rather than psychiatrists even in a country like Japan where patients are allowed to go directly to specialized doctors (Kawakami, 2007). It was reported that among those who sought any medical treatment for depression, only about half sought help from psychiatrists in Japan. However, primary care physicians usually fail to recognize 30 to 50% of depressed patients (Simon and VonKorff, 1995). It may be difficult for general practitioners to detect depressed patients because patients do not often reveal their depressed mood. A study showed that 77% of patients with depression in Japan reported only somatic symptoms as the reason for visiting the physician (Simon et al., 1999). Therefore, useful screening test for depressive disorders at primary care settings is required.

There are mainly three types of depression adopted by American Psychiatric Association: major depressive disorder (MDD), dysthymic disorder, and depression not otherwise specified (NOS) (American Psychiatric Association, 1994). MDD is defined by a disturbance of mood and a loss of interest or pleasure in normal everyday activities for at least 2 weeks, accompanying a minimum of 3 to 4 psychological and somatic symptoms. It was reported that women had significantly higher lifetime risk of having MDD than men (Seedat et al., 2009). Dysthymic disorder is characterized by more chronic but less severe depression than MDD. Although a review supported that drug treatment would be a reasonable choice for dysthymia (Lima and Moncrieff, 2000), 12-month prevalence of dysthymia was reported to be much lower (0.7%) than that of MDD (Kawakami et al., 2005). Depression NOS includes syndromes without sufficient number of symptoms or duration to meet the criteria for MDD. Those syndromes are given other names such as 'minor depressive disorder' and 'recurrent brief depressive disorder'. A review showed that there were only a small to moderate benefit of antidepressant medications and psychological treatment for minor depression (Ackermann and Williams, 2002), and another review showed that 46 to 71% of patients with minor depressive disorder achieved remission after follow-up of 1 to 6 years (Hermens et al., 2004). Therefore, this study will focus on MDD due to its higher prevalence and potential for serious morbidity.

Several attempts were made to establish markers for MDD. A study showed that two-question case-finding was effective to detect depression (Whooley et al., 1997); however, the questions were obviously phrased and would require the physician to suspect depression in the first place, which is the main issue in missed MDD ("During the past month, have you

often been bothered by feeling down, depressed, or hopeless?” and “During the past month, have you often been bothered by little interest or pleasure in doing things?”). Although another study showed that the number of symptoms from a list of 12 somatic symptoms could be a useful predictor of major depression (Nakao and Yano, 2003), it might take a lot of time to perform this checklist. At the moment, there is no universal, brief and efficient marker for MDD which can alert primary care physicians to the possibility of depression.

Sleep disturbances were shown to be one of the symptoms most predictive of functional status and well-being of patients with MDD (Brody et al., 1998). The reported prevalence of sleep disturbances vary from 10 to 60% depending on definitions of sleep disturbances and data-collection methodologies (Ohayon, 2002). The association between sleep disturbances and MDD was reported in many studies. It was observed that 41% of depressed patients reported sufficient insomnia for an additional DSM-IV diagnosis of insomnia (Stewart et al., 2006). A study showed that 14% of patients with persistent insomnia had concurrent depression (Ford and Kamerow, 1989), and another study reported that 11% of the patients in sleep clinic had major depression (DeZee et al., 2005). In addition, severity of excessive sleepiness was associated with severity of depression (Lundt, 2005). Therefore, it was suggested that sleep disturbances could be a potential marker for MDD.

There were several studies investigating the causality between sleep disturbances and depression. While a cohort study showed that sleep complaints increased the subsequent risk of depression (Roberts et al., 2000), a review indicated that both sleep disturbances and depression were either causally related to each other and/or common causalities underlie the two diseases (Staner, 2010). It was suggested that one may precede the other, or vice versa. In addition, it was shown that sleep disturbances was the most common residual symptom of MDD, and the increased number of residual symptom was associated with higher risk of relapse of depression (Nierenberg et al., 2010). Therefore, by investigating both disorders for long enough periods, sleep disturbances can be a marker to predict MDD, detect the concurrent MDD, or detect residual symptom of MDD.

There were few studies investigating the effect of age on the association between sleep disturbances and MDD. A study reported that sleep latency was the only difference in EEG parameters between healthy and depressed elderly subjects (Vitiello et al., 1990). There were several studies investigating the effect of gender on the association between sleep disturbances and MDD. A twin study showed no difference in symptoms between depressed opposite-sex twins (Middeldorp et al., 2006). On the other hand, other studies reported that depressed women had higher prevalence of sleep disturbance than depressed men (Silverstein, 1999; Kornstein et al., 2000; Khan et al., 2002).

As far as we know, there is no study which has examined the usefulness of sleep disturbances as a marker for MDD investigating prevalence of both disorders for more than 6 months. The measures of sleep disturbances as a marker for MDD such as sensitivity and specificity have only rarely been reported. Sensitivity is defined as the probability of testing positive if the disease is truly present. Specificity is the probability of testing negative if the disease is truly absent. Those are the measures of quantifying the diagnostic ability of the test (Kalter et al., 1983; Altman and Bland, 1994c). A Japanese case-control study showed that the sensitivity and specificity of sleep disturbance as a marker for major depression were 80.0% and 86.6% (Doi et al., 2000), but this Japanese study assessed sleep disturbance only over one month. Another study has shown that the sensitivity of self-reported sleep complaints as a marker for depression was 85% and the specificity was 44% (Almeida and Pfaff, 2005); however, the subjects were limited to elderly patients who visited to general practitioners, and prevalence was measured as a point prevalence.

Although sensitivity and specificity do not provide information about the probability that the test will give correct diagnosis, predictive values provide this information (Altman and Bland, 1994a; Brenner and Gefeller, 1997). Positive predictive value (PPV) is the probability that a subject with positive test result actually has the disease, and negative predictive value (NPV) is the probability that a person with negative test result does not actually have the disease. In addition, there is a single measure of ability of diagnostic test. A summary of the performance of a test is provided by the area under the receiver operating characteristic (ROC) curve (AUC) (Altman and Bland, 1994b). The area is equivalent to the probability that a person with the disease has a higher value of the test than a person without the disease. As far as we know, estimated values of PPV, NPV, and AUC of sleep disturbances as a marker for MDD have not been reported. Therefore, research on the utility of sleep disturbances as a marker for MDD is required in which adequately long period of prevalence is applied and estimated measures are reported.

1.2 Aims and Objectives

1.2.1. Aims—The aim of this study was to investigate the utility of self-reported sleep disturbances as a marker for MDD in the general adult populations in Japan.

1.2.2. Objectives

1. To investigate the sensitivity, specificity, PPV, NPV, and AUC of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of MDD.
2. To examine utility of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of MDD in specific age and gender group.
3. To examine utility of specific type of self-reported sleep disturbance as a marker for MDD.

2. Methods

2.1 Study design

This study was a cross-sectional study which examined the association between 12-month prevalence of sleep disturbances and MDD. This study used the data obtained in the World Mental Health Japan Survey (WMH-J) which investigated prevalence of mental health diseases in Japan between 2002 and 2006.

2.2 Study sample

Study samples were general population in Japan who were aged 20 years randomly selected from voter registry of eleven communities in Japan. Exclusion criteria were the followings: those who had died, who had moved, or who did not have enough communication skills in Japanese to complete the interview. At each site, an invitation letter was sent to each subject before a trained interviewer visited the homes of the subjects to seek permission to participate in the survey (Kawakami et al., 2005). At each site except Nagasaki site, an interviewer conducted the face-to face interview with those who agreed to participate in the survey. At Nagasaki site, an interviewer visited only those who replied positively to the invitation letter. Written consent was obtained from each respondent at each site.

2.3 Location

Eleven study sites were selected considering geographic variation, population density variation, availability of site investigators, and cooperation of the local government. Those

included three urban cities (Okayama, Nagasaki, and Yokohama) and eight rural municipalities (Kushikino, Fukiage, Tamano, Ichiki, Higashi-ichiki, Sano, Tendo, and Kaminoyama).

2.4 Survey instrument

The survey used computer-assisted personal interview version of the World Mental Health (WMH) Initiative version of the WHO Composite International Diagnostic Interview (WMH-CIDI) (Kessler and Ustun, 2004). A fully structured face-to-face interview was conducted using this instrument. The original English version of WMH-CIDI was translated into Japanese by a team under the supervision of the researchers who conducted WMH-J (Kawakami et al., 2005). It had been shown that all disorders were assessed with acceptable reliability and validity both in the original CIDI and in the original version of the WMH-CIDI (Wittchen, 1994). A pilot study using the Japanese version of WMH-CIDI showed good concordance between clinical diagnosis and WMH-CIDI diagnosis of major depression (Sakai et al., 2003).

Interviewers attended a 5-day standardized instrument-specific training held at each study site before the survey which included mock interviews and role-playing exercises (Kawakami et al., 2005).

In this tool, diagnosis of MDD was based on the definition and criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (4th edn, DSM-IV). Questions about prevalence of sleep disturbances in the past 12 months were the followings: “Do you have problems getting to sleep in the past 12 months?”, “Do you have problems staying asleep in the past 12 months?”, “Do you have problems waking too early in the past 12 months?”, and “Do you have problems feeling sleepy during day in the past 12 months?”. For each question, participants were asked to choose one of the following answers: “Yes”, “No”, and “Don’t know”. In this study, those who answered positively to one or more of these questions were defined as people with sleep disturbances. Also, the severity of role impairment was assessed using the Sheehan Disability Scale (SDS), the most frequently used disability measure (Hambrick et al., 2004). The SDS consists of four items, each asking the respondent to rate on a 0–10 scale the extent to which a particular disorder interferes with function in the four role domains (home, work, social, and close relationships). The role impairment was assessed as ‘moderate or severe’ if any of four domains took the score of four or more. In addition, the question about the experience of suicidal idea was asked in the following way: “Did an experience of seriously thinking about committing suicide happen to you at any time in the past 12 months?”

An internal sampling strategy was used in all surveys to reduce respondent burden by dividing the interview into two parts (Kawakami et al., 2005). Part I was mainly composed of the socio-demographic information and diagnostic assessment, while part II was composed of correlates of a disorder. Questions about sleep disturbances were included in part II. All respondents completed part I. All part I respondents who met criteria for any mental disorder and a probability subsample of 9 to 33% of other respondents in each site were then administered part II.

2.5 Institutional base

The survey was conducted by WMH-J survey group (WMHJG). The headquarter of the WMHJG was placed at the National Institute of Mental Health, Japan (NIMH) (Kawakami et al., 2005). The WMHJG collaborated with the universities and institutions in the survey sites. The fieldwork for the survey was conducted by a survey center at each survey site.

2.6 Data analysis

Data were analyzed with SPSS version 16.0, Stata/IC 11.1 and Microsoft Excel. Missing data were checked and excluded from the analysis. The weighting for each sample was conducted to adjust for the population distribution of the survey site, response rate in the survey site, and probability of selection from the part I interview (Kawakami et al., 2005). The subsequent number of part II interview participants will be shown in weighted number. The measures such as sensitivity, specificity, PPV, NPV, and AUC of self-reported sleep disturbances as a marker for MDD were calculated with 95% confidence interval (95% CI). Exact methods were applied to calculate 95% CI when appropriate. Further, likelihood ratios were calculated which showed how many times more likely those with the disease were to have that particular result than those without the disease (Deeks and Altman, 2004).

Similar analysis was conducted under stratification by gender and four age groups (under 35 years old, between 35 and 49 years old, between 50 and 64 years old, over 65 years old). Chi-square test was performed to investigate the difference between genders. Logistic regression was conducted to examine the association between measures and age group. When there was evidence for the association between measures and age, likelihood ratio test (LRT) was performed to investigate linear association between measures and age group. Also, LRT was conducted to investigate departure from linear association between measures and age group.

The same measures were calculated for each four type of sleep disturbance and possible combination of four types of sleep disturbances. Cochran Q test was performed to investigate the association between the sensitivity, specificity, and type of sleep disturbances. As there was no optimal statistical test to examine the association between PPV, NPV, AUC, and four types of sleep disturbances, chi-square test was used as a substitute.

The same measures were calculated for sleep disturbances as a marker for MDD with suicidal thought in the past 12-months and MDD with at least moderate role impairment in the past 12-months. In terms of PPV and NPV, the association between those measures for all MDD and those for MDD with the experience of suicidal idea or role impairment was examined using McNemar's test. As there was no optimal statistical test, chi-square test was used as a substitute to investigate the association between the other measures for all MDD and those for MDD with suicidal idea or role impairment.

2.7 Ethical issues

In order to assure informed consent and confidentiality, all participants were contacted firstly by letter in which the purpose of this study and what was required to participants were written in jargon free language (Kawakami et al., 2005). For confidentiality, all data were kept anonymously and securely. The main researchers attended the Human Subjects Committees of Okayama University, Japan NIMH, Nagasaki University, Jichi Medical School, Yamagata University, and Juntendo University to obtain approval of the recruitment, consent, and field procedures.

3. Results

3.1 General results

A total of 4134 people participated in the study. The response rates were between 26.4% (Nagasaki) and 81.6% (Fukiage), and the total response rate was 55.1%. Of the 4134 participants, the proportion of female was 54.7%. The minimum and maximum age of the participants were 20 and 98 years old, respectively, and the mean age was 53.6 years old

(standard deviation 16.9 years). Proportion of people ≥ 65 years was 26.6%, which was similar to that in general population in Japan in 2005 (20.1%) (Statistics Bureau, 2006). Of the 4134 subjects, a total of 1722 participants (41.7%) were administered the part II interview. The data on those 1722 participants were used for the analysis. There were 19 missing data, and they were excluded from subsequent analysis. This sample size gave a statistical power of more than 0.99 when a disorder with the prevalence of 0.2 was measured within 10% error at a significance level of 0.95.

The relationship between demographic characteristics and MDD and sleep disturbances are shown in Table 1. Comorbid psychiatric disorders were also shown in the same table. People with the highest education had higher prevalence of MDD and sleep disturbances than those with lowest education. Married people had lower prevalence of MDD than those who had never married. In general, comorbid psychiatric disorders increased the odds of having MDD and self-reported sleep disturbances. Especially, having anxiety disorder considerably increased the odds of having MDD.

The 12-month prevalence of MDD and self-reported sleep disturbances were 3.2% and 28.0%, respectively (Table 2). With respect to subtype of sleep disturbance, 12-month prevalence of self-reported daytime sleepiness was prominently high (22.8%) among four types of sleep disturbances.

The sensitivity and specificity of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of MDD were 58.9% (95% CI 46.0 to 71.8%) and 73.4% (95% CI 70.9 to 75.2%), respectively (Table 3). The AUC could be calculated as 0.66 in the way Canter and Kattan suggested (Cantor and Kattan, 2000). Similarly, PPV and NPV were 6.9% (95% CI 4.6 to 9.2%) and 98.1% (95% CI 97.4 to 98.9%), respectively.

3.2 Gender and age group

While prevalence of self-reported sleep disturbances were similar in both gender, prevalence of MDD was higher in female than in male ($P=0.001$) (Table 2).

While the sensitivity and specificity were similar in both genders, PPV was higher in female than in male ($P=0.013$) and NPV was higher in male than in female ($P=0.020$) (Table 3).

In terms of age, there was no evidence for association between prevalence of sleep disturbances and age group ($P=0.141$) (Table 2). There was very strong evidence for linear association between prevalence of MDD and age group ($P<0.001$). The younger age group had higher prevalence of MDD.

There was strong evidence for association between sensitivity and age group ($P=0.038$), but there was also suggestive evidence for departure from linear association between sensitivity and age group ($P=0.086$) (Table 3). Although there was very strong evidence for association between PPV and age group ($P<0.001$), there was also strong evidence for departure from linear relationship between PPV and age group ($P=0.047$). Although there was very strong evidence for association between AUC and age group ($P<0.001$), there was no evidence for linear association between AUC and age group ($P=0.724$). The sensitivity, PPV, and AUC of the youngest group were considerably higher than those of older group. From those results it was suggested that the usefulness of sleep disturbances as a marker for MDD was the highest in the youngest group.

3.3 Type of sleep disturbance

There was very strong evidence for difference between prevalence of four types of sleep disturbances ($P<0.001$) (Table 2). Prevalence of daytime sleepiness was considerably higher

than the other three types of sleep disturbances. While problems getting to sleep was more prevalent in female than in male ($P=0.014$), there was no difference between genders in prevalence of the other types of sleep disturbances.

With regard to age group, although there was very strong evidence for association between age group and prevalence of problems getting to sleep ($P=0.003$), there was also very strong evidence for departure from linear relationship between age group and prevalence of problems getting to sleep ($P=0.001$). There was very strong evidence for linear association between prevalence of problems staying asleep, waking too early, daytime sleepiness and age groups ($P=0.002$, $P<0.001$, and $P=0.001$, respectively). While problems staying asleep and waking too early were more prevalent in older groups, prevalence of daytime sleepiness was higher in younger groups.

There were very strong evidences that sensitivity and specificity were different between four types of sleep disturbances ($P<0.001$ for both) (Table 4). The sensitivity of daytime sleepiness was considerably higher, and the specificity of daytime sleepiness was lower than the other types of sleep disturbances. Of the four types of sleep disturbances, the AUC was highest in daytime sleepiness.

3.4 Sleep disturbances as a marker for MDD with the experience of suicidal thought or at least moderate role impairment

The 12-month prevalence of MDD with experience of suicidal thought and MDD with at least moderate role impairment were 0.5% and 2.5%, respectively (Table 5). The measures for overall MDD were compared with those for MDD plus suicidal thought or role impairment. There were very strong evidences that PPV for MDD with the experience of suicidal thought or role impairment were lower than PPV for overall MDD ($P<0.001$ and $P=0.044$). There were also very strong evidences that NPV were higher for MDD with the experience of suicidal thought or role impairment than for overall MDD ($P<0.001$ and $P=0.008$). The AUC for MDD with experience of suicidal thought or role impairment were higher than for overall MDD ($P<0.001$ for both). Therefore, sleep disturbances was a better marker for MDD with experience of suicidal thought or at least moderate role impairment than for overall MDD.

3.5 Role impairment combined with sleep disturbances as a marker for MDD

With at least moderate role impairment combined with self-reported sleep disturbances as a marker for MDD, PPV rose up to 80.0% while sensitivity decreased down to 50.0%. The specificity and NPV were 99.6% and 98.3%, respectively.

4. Discussion

4.1 Utility of sleep disturbances as a marker for MDD

This study estimated the measures of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of MDD. Those values were generally consistent with other studies (Ohayon, 2002; DeZee et al., 2005; Stewart et al., 2006). The sensitivity appeared to be higher than a British study (Stewart et al., 2006); however, it may be because the British study used DSM-IV criteria for sleep disturbances. Although PPV was lower than another study conducted in sleep clinic (DeZee et al., 2005), this may be because general population have milder sleep disturbances than patients attending sleep clinic. Although the sensitivity and specificity were lower than those reported in Japanese case-control study (Doi et al., 2000), the reason may be because the Japanese study selected serious patients as cases from the NIMH.

As the AUC can be calculated as 0.66, self-reported sleep disturbances is evaluated 'fair' as a diagnostic test based on discussion of ROC curve analysis by Weinstein and Fineberg (Weinstein and Fineberg, 1980). However, as the positive and negative likelihood ratio was calculated as 2.2 and 0.5, self-reported sleep disturbances does not give strong evidence to rule in or rule out diagnosis of MDD (Deeks and Altman, 2004). Therefore, self-reported sleep disturbances cannot be used in isolation for screening MDD. For those with sleep disturbance, further testing for MDD is recommended due to the demonstrated association with MDD (Ford and Kamerow, 1989; DeZee et al., 2005). If combined with at least moderate role impairment, self-reported sleep disturbances become more informative screening test with positive likelihood ratio of 125 which means the screening test gives strong evidence to rule in and out MDD (Deeks and Altman, 2004).

Also, considering the serious prognosis of MDD and usually non-invasive additional test for MDD (Murray and Lopez, 1997), another screening test with higher sensitivity is recommended to use in parallel with self-reported sleep disturbances.

4.2 Effect of gender and age

The differences between genders in PPV and NPV may come from higher prevalence of MDD in female. It can be said that gender did not modify the association between sleep disturbances and MDD, which is compatible with the result of the twin study (Middeldorp et al., 2006).

Observed higher prevalence of MDD in younger group is compatible with another study (Hollingworth et al., 2010). However, selection bias for younger groups should be considered. Healthy young people tend to work long hours in Japan and may not have time to respond to interview. Young people with MDD may be too unwell to work and subsequently may have more time to participate in the study, introducing selection bias. High PPV in the youngest group may also be biased by high prevalence of MDD in younger group due to selection bias. Nevertheless, the association between sleep disturbance and MDD cannot be biased. Therefore, we can conclude that sleep disturbances was more useful as a marker for MDD in the youngest group than in older groups because the sensitivity and AUC were highest among all the age groups.

4.3 Type of sleep disturbance and combination of four types of sleep disturbances

In terms of type of sleep disturbance, daytime sleepiness showed the highest performance as a marker for MDD among four types of sleep disturbances considering its highest sensitivity and AUC. Although problems staying asleep and waking too early were more prevalent in older groups, daytime sleepiness was more prevalent in younger groups. It may be because young persons are required to be more awake than older persons due to higher proportion of employment status. As far as we searched, there has been no biological explanation for higher prevalence of daytime sleepiness in younger people.

4.4 Limitation

Considering the similarity of the demographic characteristics of the participants of this study and general population in Japan in 2005, it can be said that the samples were fairly representative of general population in Japan. The response rate was relatively low in Nagasaki site, but it may be because the site used different recruitment method.

There are considerable limitations to the generalizability of the result of this study. As the survey sites were limited only in Japan, the applicability of this result to the whole world is questionable. Also, most survey sites were located in western Japan, which might decrease

the representativeness of general population in Japan. The participants were restricted to people aged over 20 years old.

As the average response rate was low, there might be selection bias. There might be stronger association with mental illness in those who could afford time to conduct interview than those who could not. Especially for younger generations, as stated above, this selection bias might be larger. Therefore, prevalence and PPV might be overestimated, and NPV might be underestimated especially in younger groups.

In addition, there might be a recall bias because this research assessed prevalence of mental illness in the past 12-months (Simon and VonKorff, 1995). Therefore, prevalence and PPV might be underestimated, and NPV might be overestimated especially in the oldest group.

Also, there might be responder bias in this study. Some people might not want to reveal nor admit their mental illness. Therefore, prevalence and PPV of MDD might be underestimated, and NPV might be overestimated in all age groups. Furthermore, as sleep disturbance was investigated using Likert scale with a few choices, we could not specify the severity of the sleep disturbance.

Considering all bias stated above, PPV might be underestimated and NPV might be overestimated in the oldest group. Furthermore, the results may vary depending on the degree of psychiatric comorbidity, which was not fully investigated in the present study.

4.5 Implication for clinical practice

As the AUC and likelihood ratio are not very high, self-reported sleep disturbances cannot be a screening test for MDD in isolation. Combined with at least moderate role impairment, self-reported sleep disturbances yields PPV of 80.0% and NPV of 98.3%. Therefore, it is recommended that clinicians would ask about role impairment of those with sleep disturbances. However, as the sensitivity of the test becomes as low as 50.0%, it is recommended that another screening test with high sensitivity is used in parallel.

Considering the high performance of self-reported sleep disturbances as a marker for MDD in the young group, clinicians should be cautious about MDD when facing young patient with sleep disturbances. In terms of type of sleep disturbances, clinicians should ask questions about daytime sleepiness to young patients.

There are several reasons to support the use of self-reported sleep disturbances as a marker for MDD. Because of the seriousness and benefit from early detection and favourable prognosis (Murray and Lopez, 1997; Royal Australian and New Zealand College of Psychiatrists, 2004), MDD is appropriate for screening. Self-report of sleep disturbance is not costly and is easy to administer without discomfort. As questions about sleep disturbances are easy to remember, the test has a potential to be available anywhere.

4.6 Recommendation for future research

The association between sleep disturbances and MDD in children and adolescent should be investigated. In terms of biology, biological research investigating daytime sleepiness among young adult would be interesting.

4.7 Conclusion

Because 12-month prevalence of self-reported sleep disturbances had only a fair validity as a marker for 12-month prevalence of MDD, self-reported sleep disturbances cannot be a marker for MDD in isolation. Comorbid serious role impairment increases probability of

MDD. Clinicians should be cautious about young people who have sleep disturbances. Daytime sleepiness should be included in the question asking about sleep disturbances.

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References

- Ackermann RT, Williams JW Jr. Rational treatment choices for non-major depressions in primary care: an evidence-based review. *Journal of General Internal Medicine*. 2002; 17:293–301. [PubMed: 11972726]
- Almeida OP, Pfaff JJ. Sleep complaints among older general practice patients: association with depression. *The British journal of general practice*. 2005; 55:864–866. [PubMed: 16282003]
- Altman DG, Bland JM. Diagnostic tests 2: Predictive values. *British Medical Journal*. 1994a; 309:102. [PubMed: 8038641]
- Altman DG, Bland JM. Diagnostic tests 3: receiver operating characteristic plots. *British Medical Journal*. 1994b; 309:188. [PubMed: 8044101]
- Altman DG, Bland JM. Diagnostic tests. 1: Sensitivity and specificity. *British Medical Journal*. 1994c; 308:1552. [PubMed: 8019315]
- American Psychiatric Association. DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders American Psychiatric Association. Washington D.C. and London, England: 1994.
- Brenner H, Gefeller O. Variation of sensitivity, specificity, likelihood ratios and predictive values with disease prevalence. *Statistics in medicine*. 1997; 16:981–991. [PubMed: 9160493]
- Brody DS, Hahn SR, Spitzer RL, Kroenke K, Linzer M, Degruy FV 3rd, Williams JB. Identifying patients with depression in the primary care setting: a more efficient method. *Archives of internal medicine*. 1998; 158:2469–2475. [PubMed: 9855385]
- Cantor SB, Kattan MW. Determining the area under the ROC curve for a binary diagnostic test. *Medical decision making*. 2000; 20:468–470. [PubMed: 11059479]
- Deeks JJ, Altman DG. Diagnostic tests 4: likelihood ratios. *British Medical Journal*. 2004; 329:168–169. [PubMed: 15258077]
- Dezee KJ, Hatzigeorgiou C, Kristo D, Jackson JL. Prevalence of and screening for mental disorders in a sleep clinic. *Journal of Clinical Sleep Medicine*. 2005; 1:136–142. [PubMed: 17561627]
- Doi Y, Minowa M, Uchiyama M, Okawa M, Kim K, Shibui K, Kamei Y. Psychometric assessment of subjective sleep quality using the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) in psychiatric disordered and control subjects. *Psychiatry Research*. 2000; 97:165–172.
- Eaton WW, Martins SS, Nestadt G, Bienvenu OJ, Clarke D, Alexandre P. The burden of mental disorders. *Epidemiologic Reviews*. 2008; 30:1–14. [PubMed: 18806255]
- Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? *The Journal of the American Medical Association*. 1989; 262:1479–1484.

- Hambrick JP, Turk CL, Heimberg RG, Schneier FR, Liebowitz MR. Psychometric properties of disability measures among patients with social anxiety disorder. *Journal of anxiety disorders*. 2004; 18:825–839.
- Hermens ML, Van Hout HP, Terluin B, Van Der Windt DA, Beekman AT, Van Dyck R, De Haan M. The prognosis of minor depression in the general population: a systematic review. *General hospital psychiatry*. 2004; 26:453–462. [PubMed: 15567211]
- Hollingsworth SA, Burgess PM, Whiteford HA. Affective and anxiety disorders: prevalence, treatment and antidepressant medication use. *The Australian and New Zealand journal of psychiatry*. 2010; 44:513–519. [PubMed: 20482411]
- Kalter N, Feinberg M, Carroll BJ. Inferential statistical methods for strengthening the interpretation of laboratory test results. *Psychiatry Research*. 1983; 10:207–216. [PubMed: 6582528]
- Kawakami N. Epidemiology of depressive disorders in Japan and the world. *Nippon Rinsho*. 2007; 65:1578–1584. [PubMed: 17876978]
- Kawakami N, Takeshima T, Ono Y, Uda H, Hata Y, Nakane Y, Nakane H, Iwata N, Furukawa TA, Kikkawa T. Twelve-month prevalence, severity, and treatment of common mental disorders in communities in Japan: preliminary finding from the World Mental Health Japan Survey 2002–2003. *Psychiatry and Clinical Neurosciences*. 2005; 59:441–452. [PubMed: 16048450]
- Kernick DP. Which antidepressant? A commentary from general practice on evidence-based medicine and health economics. *British Journal of General Practice*. 1997; 47:95–98. [PubMed: 9101693]
- Kessler RC, Ustun TB. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *International journal of methods in psychiatric research*. 2004; 13:93–121. [PubMed: 15297906]
- Khan AA, Gardner CO, Prescott CA, Kendler KS. Gender differences in the symptoms of major depression in opposite-sex dizygotic twin pairs. *American Journal of Psychiatry*. 2002; 159:1427–1429. [PubMed: 12153840]
- Kornstein SG, Schatzberg AF, Thase ME, Yonkers KA, McCullough JP, Keitner GI, Gelenberg AJ, Ryan CE, Hess AL, Harrison W, Davis SM, Keller MB. Gender differences in chronic major and double depression. *Journal of Affective Disorders*. 2000; 60:1–11. [PubMed: 10940442]
- Lima MS, Moncrieff J. Drugs versus placebo for dysthymia. *Cochrane Database of systematic reviews*. 2000;CD001130.
- Lundt L. Use of the Epworth Sleepiness Scale to evaluate the symptom of excessive sleepiness in major depressive disorder. *General hospital psychiatry*. 2005; 27:146–148. [PubMed: 15763128]
- Middeldorp CM, Wray NR, Andrews G, Martin NG, Boomsma DI. Sex differences in symptoms of depression in unrelated individuals and opposite-sex twin and sibling pairs. *Twin research and human genetics*. 2006; 9:632–636. [PubMed: 17032542]
- Moller HJ, Demyttenaere K, Sacchetti E, Rush AJ, Montgomery SA. Improving the chance of recovery from the short- and long-term consequences of depression. *International clinical psychopharmacology*. 2003; 18:219–225. [PubMed: 12817156]
- Murray CJL, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. *The Lancet*. 1997; 349:1498–1504.
- Nakao M, Yano E. Reporting of somatic symptoms as a screening marker for detecting major depression in a population of Japanese white-collar workers. *Journal of clinical epidemiology*. 2003; 56:1021–1026. [PubMed: 14568635]
- Nierenberg AA, Husain MM, Trivedi MH, Fava M, Warden D, Wisniewski SR, Miyahara S, Rush AJ. Residual symptoms after remission of major depressive disorder with citalopram and risk of relapse: a STAR*D report. *Psychological medicine*. 2010; 40:41–50. [PubMed: 19460188]
- Ohayon MM. Epidemiology of insomnia: what we know and what we still need to learn. *Sleep medicine reviews*. 2002; 6:97–111. [PubMed: 12531146]
- Roberts RE, Shema SJ, Kaplan GA, Strawbridge WJ. Sleep complaints and depression in an aging cohort: A prospective perspective. *American Journal of Psychiatry*. 2000; 157:81–88. [PubMed: 10618017]
- Royal Australian and New Zealand College of Psychiatrists Clinical Practice Guidelines Team for Depression. Australian and New Zealand clinical practice guidelines for the treatment of

- depression. [Miscellaneous Article]. *The Australian and New Zealand Journal of Psychiatry*. 2004; 38:389–407. [PubMed: 15209830]
- Sadock, BJ.; Sadock, VA. *Kaplan and Sadock's Synopsis of Psychiatry: Behavioral Sciences/clinical Psychiatry*. Lippincott Williams and Wilkins, US; 2007.
- Sakai, A.; Ito, K.; Takeuchi, K. Reliability and validity. *Kokoro No Kenkyu Ni Kansuru Ekigaku Chousa No Jisshi Houhou Ni Kansuru Kenkyu: Heisei 14 Nen Soukatsu-Buntan Houkokusho*. Ichikawa: National Institute of Mental Health; 2003.
- Seedat S, Scott KM, Angermeyer MC, Berglund P, Bromet EJ, Brugha TS, Demyttenaere K, De Girolamo G, Haro JM, Jin R, Karam EG, Kovess-Masfety V, Levinson D, Medina Mora ME, Ono Y, Ormel J, Pennell BE, Posada-Villa J, Sampson NA, Williams D, Kessler RC. Cross-national associations between gender and mental disorders in the World Health Organization World Mental Health Surveys. *Archives of general psychiatry*. 2009; 66:785–795. [PubMed: 19581570]
- Silverstein B. Gender difference in the prevalence of clinical depression: the role played by depression associated with somatic symptoms. *American Journal of Psychiatry*. 1999; 156:480–482. [PubMed: 10080570]
- Simon GE, Vonkorff M. Recognition, management, and outcomes of depression in primary care. *Archives of family medicine*. 1995; 4:99–105. [PubMed: 7842160]
- Simon GE, Vonkorff M, Piccinelli M, Fullerton C, Ormel J. An international study of the relation between somatic symptoms and depression. *The New England journal of medicine*. 1999; 341:1329–1335. [PubMed: 10536124]
- Staner L. Comorbidity of insomnia and depression. *Sleep medicine reviews*. 2010; 14:35–46. [PubMed: 19939713]
- Statistics Bureau, Director-General for Policy Planning and Statistical Research and Training institute. *Population of Japan 2005. Population Census*. Tokyo: Ministry of Internal Affairs and Communications; 2006.
- Stewart R, Besset A, Bebbington P, Brugha T, Lindesay J, Jenkins R, Singleton N, Meltzer H. Insomnia comorbidity and impact and hypnotic use by age group in a national survey population aged 16 to 74 years. *Sleep*. 2006; 29:1391–1397. [PubMed: 17162985]
- Vitiello MV, Prinz PN, Avery DH, Williams DE, Ries RK, Bokan JA, Khan A. Sleep is undisturbed in elderly, depressed individuals who have not sought health care. *Biological psychiatry*. 1990; 27:431–440. [PubMed: 2178692]
- Weinstein, M.; Fineberg, H. *Clinical Decision Analysis*. Philadelphia: W.B. Saunders; 1980.
- World Health Organization. *The world health report 2001 -Mental Health: New Understanding, New Hope*. The world health report World Health Organization; 2001.
- World Health Organization. *What are the most effective diagnosis and therapeutic strategies for the management of depression in specialist care?.* Regional Office for Europe's Health Evidence Network; 2005.
- Whooley MA, Avins AL, Miranda J, Browner WS. Case-finding instruments for depression. Two questions are as good as many. *Journal of general internal medicine*. 1997; 12:439–445. [PubMed: 9229283]
- Wittchen HU. Reliability and validity studies of the WHO—Composite International Diagnostic Interview (CIDI): a critical review. *Journal of psychiatric research*. 1994; 28:57–84. [PubMed: 8064641]

Relation between demographic factors and 12-month prevalence of major depressive disorder and self-reported sleep disturbances

Table 1

	N	Major depressive disorder		Self-reported sleep disturbances	
		% (SE)	OR (95% CI)	% (SE)	OR (95% CI)
Demographic characteristics					
Education (years)					
≤11	467	1.5 (0.6)	1.0	23.8 (2.0)	1.0
12	545	3.3 (0.8)	2.3 (0.9–5.5)	25.5 (1.9)	1.1 (0.8–1.5)
13–15	309	4.2 (1.1)	2.9 (1.1–7.3)	32.9 (2.7)	1.6 (1.1–2.2)
≥16	325	5.5 (1.3)	3.8 (1.6–9.3)	32.5 (0.7)	1.5 (1.1–2.1)
Marital Status					
Never Married	247	4.0 (1.2)	1.4 (0.7–2.8)	33.6 (3.0)	1.4 (1.0–1.9)
Previously married	235	3.8 (1.2)	1.2 (0.6–2.6)	28.9 (3.0)	1.1 (0.8–1.5)
Married	1218	3.1 (0.5)	1.0	26.6 (1.3)	1.0
Occupational status					
Unemployed	623	2.7 (0.6)	1.0	27.6 (1.8)	1.0
Employed	1077	3.7 (0.6)	1.4 (0.8–2.6)	28.1 (1.4)	1.0 (0.8–1.3)
Any other mood disorder (bipolar)					
Yes	7	0.0 (0.0)	-	85.7 (13.2)	27.2 (1.7–426.0)
No	1715	3.3 (0.4)	-	27.7 (1.1)	1.0
Any anxiety disorder					
Yes	121	19.0 (3.6)	10.6 (6.0–8.7)	45.3 (4.6)	2.3 (1.6–3.3)
No	1601	2.1 (0.4)	1.0	26.7 (1.1)	1.0
Any substance disorders					
Yes	25	12.0 (6.5)	3.9 (1.1–13.9)	44.0 (9.9)	2.0 (0.9–4.4)
No	1697	3.2 (0.4)	1.0	27.7 (1.1)	1.0
Total		3.2 (0.4)		28.0 (1.1)	

Twelve-month prevalence of major depressive disorder (MDD), total self-reported sleep disturbance, and four types of self-reported sleep disturbances under stratification by gender or four age groups

Table 2

	MDD		Self-reported sleep disturbances	problem getting to sleep	problem staying asleep	waking too early	daytime sleepiness
	N	(prevalence, %)	N (prevalence, %)	N (prevalence, %)	N (prevalence, %)	N (prevalence, %)	N (prevalence, %)
Total	1703	56 (3.2)	477 (28.0)	86 (5.0)	101 (5.9)	121 (7.1)	388 (22.8)
Gender							
Male	844	15 (1.8)	230 (27.3)	32 (3.8)	52 (6.2)	67 (7.9)	187 (22.2)
Female	858	41 (4.8)	247 (28.8)	55 (6.4)	49 (5.7)	54 (6.3)	201 (23.4)
		P=0.001	P=0.480 ^{*1}	P=0.014 ^{*1}	P=0.694	P=0.187	P=0.524
Age (years)							
20~34	402	25 (6.2)	133 (33.1)	26 (6.5)	14 (3.5)	9 (2.2)	120 (29.9)
35~49	405	12 (3.0)	112 (27.7)	10 (2.5)	20 (4.9)	21 (5.2)	100 (24.7)
50~64	459	12 (2.6)	109 (23.7)	18 (3.9)	25 (5.4)	36 (7.8)	93 (20.3)
65~	435	5 (1.1)	122 (28.0)	32 (7.4)	43 (9.9)	55 (12.6)	74 (17.0)
		P=0.001 ^{*2}	P=0.141 ^{*2}	P=0.003 ^{*2}	P=0.007 ^{*2}	P<0.001 ^{*2}	P=0.006 ^{*2}
		P<0.001 ^{*3}		P=0.003 ^{*3}	P=0.002 ^{*3}	P<0.001 ^{*3}	P=0.001 ^{*3}

^{*1} P-value from chi-squared test,

^{*2} Likelihood ratio test for association between values and age groups,

^{*3} Likelihood ratio test for linear association between values and age groups

^{*4} Chi-square test for association between values and age group

Sensitivity, Specificity, PPV ^{*1}, NPV ^{*2}, and AUC ^{*3} of 12-month prevalence of self-reported sleep disturbance as a marker for 12-month prevalence of major depressive disorder (MDD) under stratification by gender or four age groups

Table 3

(N)	Sensitivity		Specificity		PPV		NPV		AUC	
	%	(95% CI ^{*4})	%	(95% CI)	%	(95% CI)	%	(95% CI)	(95% CI)	(95% CI)
Total (1703)	58.9	(46.0–71.8)	73.4	(70.9–75.2)	6.9	(4.6–9.2)	98.1	(97.4–98.9)	0.66	(0.66–0.66)
Gender										
Male (844)	60.0	(35.2–84.8)	73.3	(70.3–76.4)	3.9	(1.4–6.4)	99.0	(98.2–99.8)	0.67	(0.66–0.67)
Female (858)	58.5	(43.5–73.6)	72.7	(69.7–75.8)	9.7	(6.0–13.4)	97.2	(95.9–98.5)	0.66	(0.65–0.66)
	P=0.921 ^{*5}		P=0.771		P=0.013		P=0.020		P=0.003	
Age (years)										
20–34 (402)	80.0	(64.3–95.7)	70.0	(65.4–74.7)	15.0	(9.0–21.1)	98.1	(96.5–99.8)	0.75	(0.74–0.76)
35–49 (405)	33.3	(6.7–60.0)	72.5	(68.1–76.9)	3.6	(0.1–7.0)	97.3	(95.4–99.1)	0.53	(0.52–0.54)
50–64 (459)	41.7	(13.8–69.6)	76.7	(72.8–80.7)	4.6	(0.7–8.5)	98.0	(96.5–99.5)	0.59	(0.58–0.60)
65~ (435)	60.0	(17.1–100.0)	72.3	(68.1–76.6)	2.5	(0.0–5.2)	99.4	(98.5–100.0)	0.66	(0.65–0.68)
	P=0.038 ^{*6}		P=0.352 ^{*6}		P<0.001 ^{*6}		P=0.352 ^{*6}		P<0.001 ^{*7}	

^{*1} Positive predictive value,

^{*2} Negative predictive value,

^{*3} Area under the receiver operating characteristic curve,

^{*4} Confidence Interval,

^{*5} P-value from chi-squared test for association between values and gender,

^{*6} Likelihood ratio test for association between values and age groups,

^{*7} Chi-square test for association between values and age group

Sensitivity, Specificity, PPV ^{*1}, NPV ^{*2}, and AUC ^{*3} of four types of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of major depressive disorder (MDD) in the total of 1703 participants

Table 4

	Sensitivity		Specificity		PPV		NPV		AUC (95% CI)
	%	(95% CI ^{*4})	%	(95% CI)	%	(95% CI)	%	(95% CI)	
Type of sleep disturbance									
problems getting to sleep	21. 8	(11.8–35. 0)	95. 5	(94.4–96. 5)	14. 0	(7.4–23. 1)	97. 3	(96.4–98. 1)	0.5 8 (0.58–0.59)
problems staying asleep	24. 1	(13.5–37. 6)	94. 7	(93.5–95. 7)	12. 9	(7.0–21. 0)	97. 4	(96.5–98. 2)	0.5 9 (0.59–0.60)
problems waking too early	12. 7	(5.3–24.5)	93. 1	(91.7–94. 3)	5.8 (2.4–11. 6)		97. 0	(96.0–97. 8)	0.5 3 (0.53–0.5 3)
daytime sleepiness	52. 7	(38.8–66. 3)	78. 2	(76.1–80. 2)	7.5 (5.1–10. 6)		98. 0	(97.1–98. 7)	0.6 5 (0.65–0.6 6)
	P<0.001 ^{*5}		P<0.001 ^{*5}		P=0.066 ^{*6}		P=0.357 ^{*6}		P<0.001 ^{*6}

^{*1} Positive predictive value

^{*2} Negative predictive value,

^{*3} Area under the receiver operating characteristic curve,

^{*4} Confidence interval,

^{*5} P-value from Cochran Q test,

^{*6} As there was no optimal statistical test, chi-square test for association between values and type of sleep disturbances was performed as a substitute

Sensitivity, Specificity, PPV ^{*1}, NPV ^{*2}, and AUC ^{*3} of 12-month prevalence of self-reported sleep disturbances as a marker for 12-month prevalence of major depressive disorder (MDD) with suicidal idea or MDD with at least moderate role impairment in the past 12-months

Table 5

	N (prevalence, %)	Sensitivity		Specificity		PPV		NPV		AUC	
		%	(95% CI ^{*4})	%	(95% CI)	%	(95% CI)	%	(95% CI)		(95% CI)
MDD + suicidal thought in the past 12-months	8 (0.5)	75 .0	(34.9–96.8)	72 .2	(70.0–74.3)	1. 3	(0.5–2.7)	99 .8	(99.4–100.0)	0. 74	(0.73–0.74)
		P=0.770 ^{*5}		P=0.870		P<0.001 ^{*6}		P<0.001		P<0.001 ^{*5}	
MDD + at least moderate role impairment	43 (2.5)	65 .1	(50.9–79.4)	73 .0	(70.8–75.1)	5. 9	(3.8–8.0)	98 .8	(98.2–99.4)	0. 69	(0.69–0.69)
		P=0.831 ^{*5}		P= 1.000		P=0.044 ^{*6}		P=0.008		P<0.001 ^{*5}	

^{*1} Positive predictive value,

^{*2} Negative predictive value,

^{*3} Area under the receiver operating characteristic curve,

^{*4} Confidence interval,

^{*5} As there was no optimal statistical test, chi-square test was performed as a substitute to investigate the association between those measures and the measures calculated for sleep disturbances as a marker for all MDD,

^{*6} P-value from McNemar's test