

学位論文

Effects of Brief CBT-I on Sleep Quality and Psychological Distress in  
Shift Workers without Midnight Shift

(深夜を含まない交代勤務者に向けた不眠に対する簡易認知行  
動療法による睡眠の質と精神的苦痛に対する効果)

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## 著者の宣言

本学位論文は、著者の責任において実験を遂行し、得られた真実の結果に基づいて正確に作成したものに相違ないことをここに宣言する。

## 要 旨

### 背景

交代勤務や不規則勤務は、睡眠の問題や精神的苦痛の原因となる可能性が示唆されている。Scott AJ らによれば、交代勤務時間が増えるほど、大うつ病に罹患する生涯リスクが高まることが示されている。

一過性の睡眠の問題や精神的苦痛に対しては、薬物的介入も効果的かもしれないが、交代勤務労働者においては、持ち越し効果や長期間の使用による耐性や依存性の問題から、介入の第一選択ではない。

夜勤を含むシフトワークでは、サーカディアンリズムを乱すことへ影響が強いと考えられ、シフトスケジュールそのものの改善が健康への悪影響を軽減するための優先策と考えられるが、スケジュールの変更は現実的には容易ではない。一方、夜勤を含まないシフトワークの場合、生活上の工夫によってサーカディアンリズムの乱れを最小限にし、適切な睡眠時間を確保することも可能と思われる。こうした生活上の工夫のためには適切な睡眠衛生教育が提供されるべきであろう。

これまでの研究では、睡眠衛生教育の効果は限定的であることが示されている。しかし、これらの研究における対象者の多くは、不眠症をはじめとした睡眠障害の治療を受けている通院患者であり、夜勤を含まない交代勤務者を対象とした研究はほとんど行われていない。

今回我々は夜勤を含まない交代勤務労働者を対象に、不眠に対する簡易認知行動療法を用いた短時間の睡眠衛生教育（以下、Brief CBT-I）を実施し、労働者の睡眠の質と精神的苦痛が改善するかを調べた。

### 方法

#### 《参加者と手続き》

機械部品メーカーの1事業場に勤務する労働者380名を対象とした。その中で深夜を含まない2交代勤務（8時間シフト）に従事する労働者を適用基準とした。研究参加の除外基準は設けなかった。当該事業場の交代勤務スケジュールは、日勤（6:30-15:30、途中1時間の昼食休憩含む）が月-金曜日の5日間連続、2日間の休日、夕勤（15:00-24:00、途中1時間の夕食休憩含む）の5日間連続、2日間の休日、が繰り返されるパターンであった。

研究への参加は個人の自由意志によるものとした。研究への同意は、Brief CBT-Iを用いた教育の実施前に、本研究の目的と手順、介入の内容を口頭と文書で説明した上で確認された。

研究への参加に同意した労働者は、無作為に、Brief CBT-I を受ける群と、waiting list 群の 2 つの群に割り付けられた。倫理的配慮から Waiting list 群に対して研究終了後同様の教育を行った。

教育の効果は、教育前と教育 2 か月後に自記式質問票を用いて調べた。質問票は完全に封がされた状態で回収された。本研究は、当該事業場の安全衛生委員会と北里大学倫理委員会による承認を受けた。

#### 《介入》

90 分間の Brief CBT-I を用いた集団教育が、夕勤後に事業場内で集団での講義形式で行われた。教育の講師は、不眠に対する簡易認知行動療法を用いた教育についての研修を受けた共同研究者が担当した。

#### 《睡眠衛生教育》

Brief CBT-I は、睡眠障害の対応と治療ガイドライン（厚生労働省の研究班）と米国の国立衛生研究所(National Institutes of Health, NIH)が作成したマニュアル、米国睡眠医学会(AMERICAN ACADEMY SLEEP OF MEDICINE, AASM)が一般者向けに作成した 16 の提言を参考にしながら、システムエンジニア用にアレンジされた。特に、夕勤によって生じるサーカディアンリズムの乱れを出来るだけ小さくすることに重点が置かれた。下記にそのポイントをいくつか示す。

- 帰宅後はできるだけ早く眠るようにしましょう。
- 前夜多少寝る時間が遅くなっても、あまり遅くまで寝ないようにしましょう。
- 眠気が強い場合には適宜仮眠を 15～20 分とりましょう。遅番中の眠気や疲労の防止になります。
- 勤務後はできるだけ沢山の夜食はとらないようにしましょう。寝る前の食事は睡眠を浅くします。

#### 《アウトカムについて》

睡眠の質については、Pittsburgh Sleep Quality Index(PSQI)を使用した。臨床的にも公衆衛生学的にも広く使用されている睡眠の質を評価するスタンダードな指標であり、PSQI の日本語版の信頼性、妥当性も十分に検証されている。PSQI は、1ヶ月前の睡眠の量と質について 7 つの構成要素（睡眠の質、睡眠潜時、睡眠時間、睡眠効率、睡眠障害、睡眠薬使用の有無、昼間の機能障害）により評価される。これら 7 つの構成要素を総合して、総合的な睡眠の質のスコア (0-21) となる。点数が高いと睡眠の質が低いことを示す。

精神的苦痛の度合いについては、K6 を用いて評価された。K6 は過去 1 か月間の抑うつ症状や不安症状の頻度を訪ねる簡便な自記式質問票である。うつ病や不安障害に対するスクリーニングとして開発され、現在精神的苦痛の評価ツールとして広く使用されている。日本語版についても K6 の信頼性・妥当性の検証がされている。

参加者の基本属性として、性別、年齢、飲酒習慣、喫煙習慣、運動習慣、睡眠障害や精神疾患の既往について調べた。

## 《解析》

解析は、intention-to-treat principle に基づいて行われ、介入の効果は線形混合モデル (linear mixed model) における group×time interaction の統計学的有意性と、2 か月後の介入群と waiting list 群のアウトカムの違いによって評価された。

## 結果

311 名の労働者が研究対象となり、156 名が介入群に、155 名が waiting list 群に無作為に割り付けられた。介入群 156 名中 149 名 (95.5%) が睡眠衛生教育を受けた。PSQI と K6 の両方において group×time interaction は有意であった ( $F_{1,304.6} = 9.30, p < 0.01$ ;  $F_{1,305.1} = 3.83, p = 0.048$ )。効果量 (Cohen's d) はそれぞれ 0.42 (95% CI, 0.20 to 0.66) と 0.25 (95% CI, 0.02 to 0.47) であった。

## 考察

今回の研究にて、夜勤を含まない 2 交代勤務者に対する Brief CBT-I を用いた睡眠衛生教育は、主観的な睡眠の質と精神的苦痛を有意に改善させることが示された。本教育プログラムは、非薬物的な 90 分という短時間の教育的介入であり、こうした多くの事業場で実施可能な介入の睡眠の質と精神的苦痛に対する改善効果が認められたことは意義深い。

これまでの研究では、睡眠衛生教育の睡眠の問題に対する効果は限定的であることが示されている。これは、これまでの研究対象者が、睡眠障害を抱えた患者であったり、交代勤務者を対象とした研究でも夜勤を伴う交代勤務者であったりしたことと関係していたと思われる。

また、睡眠の問題は個人個人でアプローチすべきポイントに違いがあるため、集団衛生教育だけでなく、個別に対応することが必要と考えられている。なかでも、非薬物的な介入として、睡眠衛生教育に、刺激コントロール法および睡眠制限法などの行動療法、リラクゼーション法、睡眠のための認知療法を組み合わせた方法 (Cognitive behavioral therapy for insomnia, CBT-I) がスタンダードな方法として推奨されている。しかし、個別の CBT-I を実施するには、CBT-I の専門家によるサポートと多くの時間も必要となる。また CBT-I の専門家が日本には少ないという問題もある。

本研究では、交代勤務でも深夜勤務を含まない交代勤務者を対象とした場合には、CBT-I の要素を含む Brief CBT-I を用いた睡眠衛生教育だけでも労働者の睡眠の改善に対し有意な効果があることが示唆された。

本研究では、Brief CBT-I を用いた睡眠衛生教育で、睡眠の改善だけでなく、精神的苦痛を改善させたこと (その効果量は小さいものではあるが) は大変意義深いことと考えられる。日本人の労働者調査では、仕事や就業生活に関して主観的に強い不安、悩み、ストレスを感じている労働者の割合は 58% に達していると報告されている (厚生省、労働者健康状況調査)。しかしながら何らかのケアが必要と思われる強い精神

的苦痛を感じている労働者のうち約2割しか適切なケアを受けていないとの報告がある。精神的苦痛の持続と増悪は様々な精神疾患や身体疾患に結びつく可能性があるだけでなく労働者の業績や生産性を低下させる可能性がある。

従って労働者の精神的苦痛を低減させるための対策は職域での焦眉の課題となっている。しかしながら、これまでの研究で、労働者の精神的苦痛の対策として、簡便で有効な対策はほとんど示されていない。CBT-I は精神的苦痛も有意に改善することが示されているが、やはり専門家によるサポートや多くの時間を要するため多くの事業場で実施するのは実際のところ困難である。

本研究の結果は、すべての労働者の精神的苦痛対策に有効というわけではないが、夜勤を伴わない交代勤務者に対しては、集団睡眠衛生教育が精神的苦痛の改善対策としても有用性が高く、実行可能性からも優先的に実施すべき対策であることを示唆している。

## 限界

今回の研究結果を一般化するにはいくつかの限界がある。1つ目は観察期間が短かったことである。本研究では、waiting list 群に対する教育があまり遅くならないようにと職場の安全衛生委員会からの要望があったため、観察期間は2か月間と短期であった。PSQI を使った睡眠の質の評価や精神的苦痛の評価にはもっと長期のフォローアップ期間が望ましかった。2つ目は睡眠の質の評価は、主観的な評価のみでポリノムノグラフィーなどの客観的な評価をとり入れなかったことである。アクチグラフィーは比較的簡易に取り付けられることから検討するべきであった。3つ目は、本研究は、他の交代勤務職場に較べ良い労働条件がそろった事業場で実施されたことである。当該事業場の2交代勤務は夜勤を伴わない8時間のシフト体制で、ほとんど残業もなく、作業も小さな機械部品の製造・組み立てで作業に伴う身体的心理的負担も少なかった。4つ目は介入群も waiting list 群も、同じ職場で働いているため、Brief CBT-I を用いた睡眠衛生教育の内容が waiting list 群にも知られてしまった可能性があることである。

## 結論

夜勤を伴わない2交代勤務者（8時間シフト）を対象としたBrief CBT-I を用いた90分間の集団睡眠衛生教育は、労働者の睡眠の質と精神的苦痛を改善させる効果があることが示唆された。本研究のBrief CBT-I を用いた集団睡眠衛生教育は短時間で実施可能な介入であり、メンタルヘルスの予防対策としても有用と考えられる。

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## **1. Abstract**

### **Objective:**

We provided brief CBT-I to shift workers who did not work midnight shifts and examined whether sleep quality and psychological distress improved.

### **Methods:**

Three hundred eleven workers participated and were randomly assigned to the intervention (156) or control (155) groups. Workers in the intervention group received a 90-minute group-based brief Cognitive Behavioral Therapy for Insomnia (CBT-I) program, which focused on minimizing circadian disturbance resulting from working evening shifts. Sleep quality and psychological distress were measured using the Pittsburgh Sleep Quality Index (PSQI) and Kessler Screening Scale for Psychological Distress (K6), respectively. Both tools were administered pre- and two months post-intervention.

### **Results:**

The results of both the PSQI and K6 showed that the group  $\times$  time interaction was significant ( $F_{1, 304.6} = 9.30$ ;  $p < 0.01$ ;  $F_{1, 305.1} = 3.83$ ;  $p = 0.048$ , respectively). The effect size (Cohen's  $d$ ) was 0.42 (95% CI, 0.20–0.66) and 0.25 (95% CI, 0.02–0.47), respectively.



**Conclusion:**

The brief CBT-I program may improve sleep quality and psychological distress in shift workers engaging in two-shift eight-hour schedules without midnight shifts.

Additionally, group-based brief CBT-I is time-saving and could prevent mental health problems.

## **2. Introduction**

Shift work and irregular working hours are associated with sleep difficulty and psychological distress. According to Scott et al<sup>1</sup>, lifetime risk for onset of major depressive disorder increases as exposure to shift work increases. The adverse health effects among shift workers are thought to be caused by circadian disruption and/or sleep deprivation related to irregular working hours and several psychological mechanisms.<sup>2</sup> Recently, the carcinogenicity of shift work has also received attention. Although adequate evidence for humans has yet to be established, laboratory animals have displayed such evidence. Indeed, in 2007, the International Agency for Research on Cancer classified "shiftwork that involves circadian disruption" as Group 2A (probably carcinogenic to humans).<sup>3-5</sup>

Pharmaceutical intervention may be effective in improving transient sleep difficulty and psychological distress. However, such interventions are not shift workers' first choice due to carry-over effects and dependency associated with long-term use.<sup>6</sup> It is thought that shift work including night shifts may be highly influenced by circadian disturbance. Although improvement in the hours of the shift schedule is considered to be the priority in reducing adverse effects on health, schedules are not easy to change in terms of practicalities. On the other hand, during non-night shifts, it may be possible to

minimize circadian disturbance through efforts in daily life, such as simply ensuring appropriate sleeping hours.

In order to help shift workers achieve these behaviors, brief CBT-I should be provided to them. Brief CBT-I includes not only sleep-related physiology and desirable lifestyles for sleep, but also specific advice for shift workers on how to mitigate the influence of desynchronization on one's biological clock and sleep-wake patterns as much as possible. Further, it explains ways to maintain a life rhythm that is matched to one's shift schedule as well as how to ensure timing for proper light exposure and nap-taking methods.

Although previous studies have demonstrated that the positive effects of brief CBT-I are limited,<sup>7</sup> most participants in these studies were outpatients who received treatment for sleep disorders, such as insomnia. Few studies have investigated workers scheduled for shift work without midnight shifts.

In the present study, we provided brief CBT-I to shift workers without midnight shifts and examined whether their sleep quality and psychological distress improved.

### **3. Materials and Methods**

#### **3-1. Participants and procedures**

Participants included 380 shift workers from one workplace, a machine-parts manufacturer. Eligibility was limited to those on two-shift (eight-hour) without midnight shift schedules. Exclusion criteria were not defined. The shift work cycle at this workplace had the following pattern: (1) day shift (6:30 to 15:30 including a one-hour lunch break) for five consecutive days from Monday to Friday; (2) two days off; (3) evening shift (15:00 to 24:00 including a one-hour evening meal break) for five consecutive days; and (4) two days off.

Participation in this study was voluntary. Consent to participate was confirmed by documents after the study objective, procedures, and contents of intervention were explained both orally and in writing. Workers who gave consent to participate were randomly assigned to either the group in which brief CBT-I would be provided or the waiting list group. According to company rules that prohibited sharing employees' health information outside the company, approval to register participants with the randomized controlled trial (RCT) registration center was not granted.

Due to ethical reasons, we provided similar brief CBT-I to the waiting list cohort after the study was completed. At this time, we also offered it to the workers who

did not provide their consent to participate in the study but were interested in receiving the brief CBT-I. The effects of the brief CBT-I were evaluated immediately prior to the brief CBT-I intervention and two months after completion using a self-administered questionnaire. The questionnaires were collected after participants completed them and enclosed them in sealed envelopes. This study received approval from both the health and safety committee at the study institution and the Kitasato University ethics committee.

### 3-2. Intervention

A 90-minute group-based brief CBT-I program was conducted in the workplace after the evening meal. The program lecturer was a collaborator in this study with training in brief CBT-I.

#### *Contents of brief CBT-I*

Educational resources were prepared with reference to the *Guidelines for Diagnosis and Treatment of Sleep Disorders* (written by the Ministry of Health, Labor, and Welfare research group)<sup>8</sup>; *Sleep, Sleep Disorders, and Biological Rhythms* (a manual prepared by the National Institute of Health)<sup>9</sup>; and *Sleep Hygiene – The Healthy*

*Habits of Good Sleep* (16 sleeping tips provided by the American Academy of Sleep Medicine).<sup>10</sup>

The education focused on minimizing circadian disturbances that result from evening shift work. For example, the subjects were advised to put off housework until the next day and to proactively adopt a relaxation method in order to prepare for initiation of sleep as soon as possible after coming back home. Details of the content provided in the brief CBT-I are shown in Table 1.

### 3-3. Outcome Measurement

#### *3-3-1. Sleep quality*

In this study, we used the Pittsburgh Sleep Quality Index (PSQI) to measure sleep quality. This is the standard index used in clinical settings in public health research.<sup>11</sup> The reliability and validity of the Japanese edition of the PSQI have been thoroughly tested.<sup>12</sup> Using the PSQI, quantity and quality of sleep during the past month were assessed according to seven dimensions: sleep quality, sleep latency, sleep time, sleep efficiency, sleep disorder, use or nonuse of sleep medication, and daytime dysfunction. After considering these, a global sleep quality score (Global PSQI score: 0–21) was calculated. A higher score indicates poorer sleep quality.

### *3-3-2. Psychological distress*

Psychological distress was evaluated using the K6. The K6 is a simple and easy-to-use self-administered questionnaire assessing the frequency of depressive and anxiety symptoms over the past month. It was developed as a screening tool for depressive disorders and anxiety disorder<sup>13</sup> and has been widely used as a tool to assess psychological distress.<sup>14-15</sup> The reliability and validity of the Japanese edition of the K6 has been verified.<sup>16</sup> The total point of K6 is shown with 0-24 points and is possible to be depressive disorders and/or anxiety disorder as high score. Cut-off point is between 8 and 9 points. Regarding background characteristics, we examined the following items: gender, age, drinking habit, smoking habit, exercise habit, and history of sleep, and psychiatric disorders.

### *3-3-3. Sample size*

The sample size required to achieve the main outcome was calculated using a two-tailed t-test. We assumed an effect size of 0.3 (small) in this study based on previous research.<sup>17</sup> The sample size necessary to obtain an effect size of 0.3 with a probability of Type I error ( $\alpha$ ) of less than 0.05 and Type II error ( $\beta$ ) of less than 0.20

was 139 for each group.

#### *3-3-4. Randomization and masking*

An independent researcher who had no direct contact with the participants used computer-generated randomization with a 1:1 ratio with a block size of 4. No stratification was performed. Evaluators were masked to allocation. Given the nature of the intervention, participants were not blind to their allocation status.

#### *3-3-5. Statistical analysis*

Statistical analyses were conducted based on an intention-to-treat (ITT) principle. The rate of missing outcomes was 1.9 % in the follow-up. To satisfy the ITT requirement that analyses be undertaken on all participants, we used multiple imputation (MI) with the assumption that the data could be considered to be missing at random. MI allows for the uncertainty of missing data by generating several different plausible imputed data sets using a set of external covariates and appropriately combining results obtained from each.<sup>18-19</sup> We used a sequential regression approach for the imputation step and generated 20 imputations for each missing value, as recommended by previous research.<sup>20</sup>



To assess the intervention effects on sleep quality and psychological distress, linear mixed models (an unstructured covariance structure) with group, time, a group  $\times$  time interaction as a fixed effect, and randomized participants as a random effect were used. Statistical significance of group  $\times$  time effects using the type III Wald test was examined. Group differences in the outcomes 2 months after the intervention were examined after adjusting for the baseline values. Statistical significance was set at  $p < 0.05$ . IBM SPSS Statistics 22 and IBM SPSS Missing Values 22 (IBM Corp, Armonk, NY, USA) were used for statistical analyses.

## 4. Results

Figure 1 presents a flow of participation in the present study. Of the 380 eligible workers, 311 individuals enrolled in the study. Eligibility was restricted to those who worked a two-shift system (8-hour shift work). These 311 participants were randomly allocated to an intervention (n = 156) or control (n = 155) group. Among the intervention group, 149 of 156 participants (95.5%) received brief CBT-I. Two months following the intervention, 154 of the 156 intervention participants (98.76%) and 151 of the 155 control participants (97.4%) responded to the follow-up survey.

### *4-1. Characteristics of the study participants*

Baseline attributes of participants are displayed in Table 2. Of the 311 participants, 170 (54.7%) were male (intervention group, 83 [53.2%]; control group, 87 [56.1%]), and the mean age was 38.7 years (intervention group, 39.7 years; control group, 37.8 years). Other basic attributes, such as the PSQI score and K6 score did not differ between groups.

### *4-2. Effect on sleep quality*

Table 3 presents the differences in change over time (group  $\times$  time interaction)

as well as the mean score of the PSQI 2 months post-brief CBT-I. The group  $\times$  time interaction term was significant ( $F_{1, 304.6} = 9.30, p < 0.01$ ) for sleep quality. Mean PSQI scores significantly differed between the two groups, with 6.95 in the intervention group and 7.88 in the control group (mean difference, 0.93 [95% CI, 0.44–1.42],  $p < 0.01$ ). The effect size (Cohen's  $d$ ) was 0.42 (95% CI, 0.20–0.66).

#### *4-3. Effect on psychological distress*

The group  $\times$  time interaction term was significant ( $F_{1, 305.1} = 3.83, p = 0.048$ ) for psychological distress as well. Mean K6 scores 2 months after the brief CBT-I were 3.07 in the intervention group and 3.69 in the control group, resulting in a significant difference between the groups (mean difference, 0.62 [95% CI, 0.05–1.19],  $p = 0.03$ ). The effect size (Cohen's  $d$ ) was 0.25 (95% CI, 0.02–0.47).

#### *4-4. Study safety*

No participants reported any detrimental effects on their sleep or mental health as a result of the study intervention.

## 5. Discussion

This study revealed that brief CBT-I significantly improved sleep quality and psychological distress in shift workers with two-shift (eight hour) schedules, without midnight shifts. This brief CBT-I program was a nonpharmacological intervention conducted over 90 minutes. It was meaningful to demonstrate the effects of the intervention improving of sleep quality and psychological distress as the education could be implemented in many workplaces.

Previous studies have shown limited effects of brief CBT-I on sleep.<sup>7</sup> However, this may be because the participants in previous studies consisted of patients with sleep disorders and that studies involving shift workers included those working night shifts. On the other hand, enough effect of improvement of insomnia is shown by adding non-standard CBT-I which is through the Internet, and are seen, and the effect continued 12 months later.<sup>21</sup> Additionally, since the key to improving sleep difficulty varies depending on the individual, not only group brief CBT-I but also individual treatment seems to be necessary.<sup>22-23</sup> Above all, as a nonpharmacological intervention, brief CBT-I combined with behavior therapy, such as stimulation control and sleep restriction, relaxation methods, and cognitive therapy for sleep (cognitive behavioral therapy for insomnia; CBT-I), have been recommended as standard methods.<sup>24-28</sup> However,

substantial time and support by specialists in CBT-I are required for individual programs. Further, the fact that there are few specialists in CBT-I in Japan is a problem. Thus, this study focused on the benefits of group education.

The present study suggests that brief CBT-I is effective in improving sleep when provided to shift workers without midnight shifts. Some explanations for this are as follows: first, the severity of circadian disturbance is mild in evening shift work compared to night shift work. Second, shift systems were regulated and systematic: the shifts of the participants in this study were eight hours and during normal hours. Conditions included no overtime work. Participants took a rest on the weekend for two days after weekday evening shifts. Further, although circadian disturbance may result from workers staying awake for a longer time than required after coming back home, or by sleeping for a longer time than required, this issue can be improved with advice on sleep hygiene and through individual effort.

At the end of brief CBT-I intervention, the participants in the intervention group were asked to describe the habits that they were going to try to adopt to improve their sleep in a free description field of the questionnaire. Of 49 participants who responded to the inquiry, the habits most commonly described as future goals were to put off housework to sleep as soon as possible after working evening shift (described by

42 [85.7%]). This can in fact be responsible for the positive results of the present study.

To our knowledge, the mechanism by which CBT-I alleviates depression and anxiety is unknown, although previous studies have suggested the endocrine system as one contributing factor.<sup>29</sup> For example, functional disorders of the hypothalamic-pituitary-adrenal axis, which are considered a pathogenic mechanism of insomnia,<sup>30</sup> are also considered to be related to other conditions such as depression and anxiety.<sup>31</sup> Further, CBT-I improves not only insomnia but also metabolic disorders in waking areas of the brain.<sup>32</sup> CBT-I might therefore improve not only subjective sleep quality but also alleviate depression and anxiety via the endocrine system or the central nervous system.

In this study, brief CBT-I improved not only the sleep quality but also psychological distress (although the effect size was small). A national survey in Japan reported that the percentage of workers who felt strong anxiety, troubled, and stressed about work and working life is 58%.<sup>33</sup> However, it has also been reported that among workers feeling strong psychological distress, which seemed to require some kind of care, approximately only 20% receive appropriate care.<sup>34</sup> Continuation and exacerbation of psychological distress may lead to various psychiatric and physical disorders, and may also reduce work performance and productivity.<sup>35-38</sup> Hence, effort to reduce

psychological distress among workers is an urgent issue in this field of research. However, few studies have aimed to show simple and effective steps for minimizing this distress. Although it is shown that CBT-I significantly improves psychological distress,<sup>39</sup> it is difficult to perform CBT-I in most workplaces due to the need for specialist support and extensive time.

Not all tools in this study were effective in reducing psychological distress for all workers. However, this study suggests that group brief CBT-I is highly useful for improving psychological distress among shift workers without midnight shifts and that implementing this type of intervention is favorable.

## 6. Limitations

There are some limitations in generalizing these results. First, the observation period was short. The observation period in this study was two months because the safety and health committee in the workplace requested that we minimize the control group's wait time for receiving the brief CBT-I. A longer follow-up period for evaluation of sleep quality and psychological distress would have been preferred. Second, evaluation of the sleep quality was based only on subjective evaluation; objective evaluations such as polysomnography were not used. In future research, actigraphy should be considered as it can be adopted relatively easily. Third, this study was performed in a workplace with nicer working conditions than many other shift-based workplaces. This workplace introduced a two-shift, eight-hour system without midnight shifts or overtime work, and the content of the work was to produce and assemble small machine parts, which has low physical and psychological burdens. Fourth, some content of the brief CBT-I may have been acquired by the control group because both the intervention group and control group worked in the same workplace.

It has also been reported that the influence of shift work and irregular working hours on sleep and mental health is not uniform and varies depending on personal characteristics and environments.<sup>40-42</sup> Therefore, to examine the validity of these results,



it is important that future research performs similar intervention studies in various workplaces.

## **7. Conclusion**

The present study indicates that a 90-minute group-based brief CBT-I program can improve sleep quality and psychological distress among shift workers engaging in two-shift eight-hour schedules without midnight shifts. Our group-based brief CBT-I required little time from shift workers and, most importantly, appears to be an effective protective measure for mental health.

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**Table 1. Contents of the sleep hygiene curriculum**

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1. Sleep structure.
  2. Number of sleeping hours needed and individual variations.
  3. Exposure to the morning sunlight upon awakening.
  4. Go to sleep as early as possible after coming back home after evening shifts and do not sleep for long periods of time the next morning.
  5. Avoid taking longer daytime naps than needed.
  6. Avoid the use of caffeinated products, nicotine, and alcohol, especially later in the day.
  7. Avoid heavy meals within one hour before going to sleep.
  8. Maintain appropriate environmental conditions for sleep.
  9. Do something to relax before going to sleep.
  10. Do not use the bedroom for activities other than sleep. (E.g., Do not read, watch TV, or talk on the phone.)
  11. If it takes a while to fall asleep (more than 30 minutes), get up and go into another room. Do something until you start to feel sleepy and then go back into the bedroom to sleep.
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**Table 2. Demographic and baseline characteristics of participants by intervention and control group**

|   | Total<br>(n = 311) | Intervention group<br>(n = 156) | Control group<br>(n = 155) |
|---|--------------------|---------------------------------|----------------------------|
| Gender: men, n (%)                        | 170 (54.7)         | 83 (53.2)                       | 87 (56.1)                  |
| Age: years, M (SD)                        | 38.7 (10.4)        | 39.7 (10.7)                     | 37.8 (10.1)                |
| Drinking habit: >1 day/week, n (%)        |                    |                                 |                            |
| <i>Yes</i>                                | 236 (75.9)         | 126 (80.7)                      | 110 (71.0)                 |
| Smoking habit, n (%)                      |                    |                                 |                            |
| <i>Yes</i>                                | 77 (24.8)          | 46 (29.5)                       | 31 (20.0)                  |
| Exercise habit: >1 day/week, n (%)        |                    |                                 |                            |
| <i>Yes</i>                                | 88 (52.4)          | 41 (49.4)                       | 47 (55.3)                  |
| History of sleep or psychiatric disorders |                    |                                 |                            |
| <i>Yes</i>                                | 14 (4.5)           | 6 (3.8)                         | 8 (5.2)                    |
| PSQI score, M (SD)                        | 7.95 (3.43)        | 7.95 (3.22)                     | 7.95 (3.63)                |
| K6 score, M (SD)                          | 3.48 (4.14)        | 3.49 (4.15)                     | 3.47 (4.14)                |

Abbreviations: SD, standard deviation; PSQI, Pittsburgh Sleep Quality Index

**Table 3. Effect of brief CBT-I on improving sleep quality and psychological distress (assessed 2 months post intervention).**

| Outcome variables  | Estimated mean (SE) <sup>†</sup> | Group difference in means (95% CI) | P-value | Group × time interaction <sup>‡</sup> |         | Effect size F (df) |
|--------------------|----------------------------------|------------------------------------|---------|---------------------------------------|---------|--------------------|
|                    |                                  |                                    |         | F (df)                                | P-value |                    |
| <b>PSQI scores</b> |                                  |                                    |         |                                       |         |                    |
| Intervention group | 6.95 (0.20)                      | 0.93 (0.44 to 1.42)                | < 0.01  | 9.30 (1, 304.6)                       | <0.01   | 0.42 (0.20–0.66)   |
| Control group      | 7.88 (0.27)                      |                                    |         |                                       |         |                    |
| <b>K6 scores</b>   |                                  |                                    |         |                                       |         |                    |
| Intervention group | 3.07 (0.26)                      | 0.62 (0.05 to 1.19)                | 0.03    | 3.81 (1, 305.1)                       | 0.048   | 0.25 (0.02–0.47)   |
| Control group      | 3.69 (0.30)                      |                                    |         |                                       |         |                    |

Abbreviations: PSQI, Pittsburgh Sleep Quality Index; SE, standard error

<sup>†</sup> Assessed after adjusting for baseline scores

<sup>‡</sup> Assessed using a linear mixed model including *group*, *time*, and *group x time*



Figure 1. Flow diagram of participant allocation

