

# A Novel Approach to Cognitive Function: Memory and Nonverbal Conceptualization

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**Abstract**—In the current study, “Brief Behavioral Treatment for Insomnia” was used to improve sleep quality in depressed patients. First, all participants, according to the population, were randomly selected and after clinical interview, they were categorized in two groups. Then, pre-test was performed on each participant and after intervention (sleep management) on experimental group, post-test was performed. Finally, data were analyzed for statistically assessing the effectiveness of intervention. There were 30 participants in the current study, who were randomly categorized into experimental (n=15) and control (n=15) groups. “Beck Depression Inventory”, “Insomnia Severity Index”, “Wechsler Memory Scale (WMS)” and “Wechsler Adult Intelligence Scale (WAIS)” were used as measures. The investigation of the effect of sleep management on cognitive function (memory and nonverbal conceptualization) in MDD with insomnia. The aim of the present study was investigating the effect of sleep management on depression, insomnia, and cognitive functions (memory and nonverbal conceptualization). To test the research hypotheses, analysis of covariance was used. The results were indicated that there is no significant difference between the groups’ post-tests on the depression variable ( $P > 0.05$ ). In addition, it was found that there is a statistically significant difference between the groups on the insomnia variable as the groups’ post-tests. The effect size, which is an indicator of the impact of the independent variable on the dependent one, was 0.24. Moreover, the results of covariance analysis for the cognitive functions (memory and nonverbal conceptualization) were shown that there is a significant difference between the groups’ post-tests on the memory sub-component ( $P < 0.05$ ). However, the difference was not significant in the case of nonverbal conceptualization ( $P > 0.05$ ). The effect size for the memory and nonverbal conceptualization was 0.30 and 0.01, respectively. To improve cognitive functions (memory and nonverbal conceptualization) in MDD with insomnia, we decided to manage sleeping in patients. We hypothesized that sleep management improve cognitive functions (memory and nonverbal conceptualization), depression and insomnia. Results were shown that only cognitive function (memory) and insomnia significantly improved by sleep management. However, depression did not shown significant differences. Moreover, we hope, sleep management along with other treatments reduces the possibility of recurrence in depressed patients. Nevertheless, it can be speculated that the findings from the present study may have implications for clinical treatment, rehabilitation and clinical research on patients with major depression.

**Index Terms**—Cognitive Function, Insomnia, Major Depressive Disorder, Sleep Management, Memory, Nonverbal Conceptualization

## 1 INTRODUCTION

Major depressive disorder and poor sleep have a reciprocal relationship: depression causes sleep disturbances, and insomnia is an independent risk factor for depression [1-8].

Difficulty sleeping is sometimes the first symptom of depression. According to the previous studies, it is found that 15 to 20 percent of people diagnosed with insomnia will develop major depression. While sleep research is still exploring the relationship between depression and sleep, previously performed studies have been shown that depressed people may have abnormal sleep patterns [9, 10]. In individuals with insomnia (40-60%) have features of depression [11]. Sleep disorder is among the most prevalent symptoms of depression, with rates of around 80 % [12, 14, 16, and 17]. Depressed patients, who have prominent insomnia, are likely to have a poorer response to treatment and their persistent sleep dis-

turbance robustly predicts a recurrence of new episodes of depression [12-22]. People with insomnia are at 9.82 times higher risk of major depression disorder than non-insomniacs' [23-29]. Although insomnia and depression have a bidirectional relationship, it is clear that depression is not experienced by all insomniacs and all depressed patients are not insomniacs.

Depressed patients show decreased amounts of non-rapid eye movement (NREM) [30]. Decreases in NREM sleep are characterized by reduced amounts of deep stages of NREM sleep and delta activity, and by increased duration of light stage 1 [31-41]. Reduced sleep quality resulting from shallow sleep might led to such a core symptom of depression as fatigue [42-47]. Changes in the temporal distribution of REM sleep segments (i.e., the first REM period is the longest and the last one is the shortest, which is the reverse of normal) are also evident in patients with depression [48-50].

Disturbed sleep may also inhibit neurogenesis in the hippocampus and increase the levels of proinflammatory cytokines [51], which could add to the development of depression or exacerbate its symptoms [52, 53].

Typical sleep symptoms in depression are including: (a) difficulty initiating sleep (initial insomnia), (b) difficulty maintaining sleep (mid insomnia), and (c) early morning waking (terminal insomnia).

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Sleepiness itself can affect daytime functioning in a number of areas including attention span and reaction time. It can also highly predict impairments in social and occupational daytime functioning, which has a negative effect on quality of life. Sleep disturbances lead to diminished reaction time, memory, psychomotor coordination, information processing and decision - making ability [54-57].

Changes in sleep occur not only as acute symptoms of depression but also as both prodromal and residual symptoms [58]. Individuals, who have achieved remission of depression, also have a high propensity for the persistence of sleep abnormalities. Nierenberg et al., [59] have shown that even when patients have responded to antidepressant therapy, residual symptoms that affect energy and sleep may persist.

The centrality of circadian rhythms in mood disorders has led to the development of specific psychosocial interventions that aim to normalize circadian rhythms. It is thought that there is a link between disruption of social rhythms and disruptions of physiological rhythms, and this may contribute toward vulnerability to depression. Social rhythms are modulated by environmental stimuli or social zeitgebers. These include social interaction, meals and other routines that share the capacity to modulate the circadian clock. Depression has the capacity to disrupt occupational and social routines, which might further increase vulnerability to mood symptoms [60].

Effective treatment for sleep problems is dependent on a clear diagnosis of the problem. The sleep problem is due to depression or another disorder. Sleep problems may also be a side effect of treatment for other health issues [61-65].

It was initially hypothesized that suppression REM sleep was the act of antidepressants, but it is proved by newer antidepressants, such as nefazadone and bupropion, that they actually enhance REM sleep. The melatonin MT1 and MT2 agonist and 5HT2C antagonist agomelatine, increases slow wave sleep and normalizes REM sleep in depression [66-75].

We used Brief Behavioral Treatment for Insomnia (BBT'I) to improve sleep quality in depressed patients. In this method, we used four techniques: stimulus control, sleep restriction, relaxation training and chronotherapy. Common elements of BBT'I are including:

- Monitoring of sleep-wake patterns
- Reinforce associations between bed and sleep
- Limit awake time in bed
- Establish regular sleep-wake schedule
- Use voluntary behavior to influence involuntary physiological process

In the current study, we used behavioral techniques to manage sleep disorder in depressed patients. Above all, we suggested a general tips to improve sleep quality in depressed people. We hypothesized that sleep management will be reduced major depression and increased cognitive abilities.

Basic behavioral tips for improving sleep quality are according to the following:

1. Because of the body's natural rhythms (called "circadian rhythms"), the best quality and largest duration sleep is obtained during nighttime.
2. Ideal sleep period equals 7- 8 hours of continuous an uninterrupted nighttime sleep, each and every night. It is preferable to get all sleep over one sustained 7-8 hours pe-

riod.

3. Sleep and rest are not the same. While resting may briefly improve the way people feels, it does not restore performance the way sleep does.
4. Reduce stimulation such as noise or lights.
5. A completely darkened room is ideal. Sleep mask/eye patches should be used if sleep area cannot be darkened.
6. People sleep better in a cooler environment. Keep the room cooler rather than warmer.
7. Avoid stimulating activities, such as work or heated discussions, before going to sleep.
8. Avoid caffeine (i.e. coffee, cola drinks, and chocolate) within 8 hours of bedtime. Although many people think that caffeine does not affect their sleep, it does.
9. Avoid smoking at least 2 hours before bedtime; nicotine is stimulating.
10. Daytime sleep adds to your 24 hour sleep cycle; avoid naps.
11. A regular exercise program helps sleep, but not if done just 2 hours before bedtime.
12. Put the bedside clock out of view to avoid 'clock watching' at night.
13. A light snack at bed time can be helpful.
14. Routine is critical. Getting up around the same time each day helps set your day/night clock; a consistent waking time is more important than bedtime.
15. A 'wind down' routine before going to bed can help relax and make it easier to sleep. This can include activities such as reading, having a warm bath or listening to music.
16. Relaxation exercises, such as progressive muscle relaxation and breathing techniques, can reduce anxiety and assist sleep. This is particularly useful for conditioned insomnia, i.e. Insomnia generated by excessive worry about not sleeping.
17. If after some time sleep does not come, get up, go into another room and do a relaxing, quiet and soothing activity such as listening to soothing music, then return to bed.

## 2 MATERIALS AND METHODS

This study was part of a broader project examining cognitive, behavior, neuropsychologic and emotional outcomes for patients with MD. Treatment and assessments for this study were carried out during 5 months in Tehran, Iran. Written consent was obtained from all participants at the start of the first assessment, after the study had been explained. All participants showed normal physical status (vision, hearing, and motor skills) and all of them were right - hand oriented.

First, all participants, according to the population, were randomly selected and after clinical interview by one of Author (Kazemi.Sh), they were categorized in two groups. Then, pre-test was performed on each participant and after intervention (sleep management) on experimental group, post-test was performed. Finally, data were analyzed for statistically assessing the effectiveness of intervention.

Fifteen control group (10 females, 5 males) and fifteen experimental groups (10 females, 5males) were participated in the present study. Depression was defined according to the

### 3 BECK DEPRESSION INVENTORY

Daytime mood was assessed with the Beck Depression Inventory (BDI), which is a 21-item measure of depression with scores ranging from 0 to 63. Higher scores indicate greater depression. It is among the most widely used depression measures and has extensive reliability and validity of data. Participants were further categorized as having minimal depression (BDI < 10) or clinically significant depression (moderate to severe) (BDI > 18). These cutoff scores were based on values derived by independent raters of psychiatric patients in an inpatient environment.

### 4 INSOMNIA SEVERITY INDEX (ISI)

The ISI is a seven item, self-report scale that addresses subjective symptoms and consequences of insomnia, as well as the degree of distress caused by these problems in the individual. It is designed to assess the nature, severity, and impact of insomnia and monitor treatment response in adults. The scale is scored on a 0 to 4 scale, with a maximum total score of 28. A score greater than 10 is considered reflective of significant insomnia. The internal consistency of this questionnaire and convergence with other insomnia measures has been well supported. The internal consistency of this scale for our sample is 0.87.

### 5 WECHSLER MEMORY SCALE (WMS-IV)

The Wechsler Memory Scale (WMS) is a neuropsychological test designed to measure different memory functions in a person. Anyone ages 16 to 90 is eligible to take this test. The current version is the fourth edition (WMS-IV), which was published in 2009 and was designed to be used with the WAIS-IV. WMS-IV is made up of seven subtests: Spatial Addition, Symbol Span, Design Memory, General Cognitive Screener, Logical Memory (I & II), Verbal Paired Associates (I & II), and Visual Reproduction (I & II). A person's performance is reported as five Index Scores: Auditory Memory, Visual Memory, Visual Working Memory, Immediate Memory, and Delayed Memory. The WMS-IV also incorporates an optional cognitive exam (Brief Cognitive Status Exam) that helps to assess global cognitive functioning in people with suspected memory deficits or those who have been diagnosed with a various neural, psychiatric and/or developmental disorders. This may include conditions such as dementias or mild learning difficulties. There is clearly observed that the WMS differentiates clinical groups (such as those with dementias or neurological disorders) from those with normal memory functioning and that the primary index scores can distinguish among the memory-impaired clinical groups.

### 6 WECHSLER ADULT INTELLIGENCE SCALE (WAIS-IV)

The current version of the test, the WAIS-IV, which was released in 2008, is composed of 10 core subtests and 5 supplemental subtests, with the 10 core subtests comprising the Full

Scale IQ. With the new WAIS-IV, the verbal/performance subscales from previous versions were removed and replaced by the index scores. The General Ability Index (GAI) was included, which consists of the Similarities, Vocabulary and Information subtests from the Verbal Comprehension Index and the Block Design, Matrix Reasoning and Visual Puzzles subtests from the Perceptual Reasoning Index. The GAI is clinically useful because it can be used as a measure of cognitive abilities that are less vulnerable to impairments of processing and working memory. Block Design subtest from WAIS was administered as part of this study. Block Design is a nonverbal conceptualization test, which includes spatial perception, visual abstract processing, and problem solving. Block Design includes nine red and white square blocks and a spiral booklet of cards showing different color designs that can be made with the blocks. The examinee must arrange the blocks to match the design formed by examiner or shown on cards. In addition to being scored for accuracy, each item is scored for speed as well.

## 7 RESULTS AND DISCUSSION

The present study confirms earlier findings that patients with major depression (untreated and with insomnia) perform weaker than under treatment patients with MDD (with insomnia) and healthy controls on some measures of cognitive functions. The results are shown that cognitive function (memory) is affected in depressed patients with insomnia in experimental group compared to control group.

According to the literature, we knew that cognitive functions disrupted by sleep disturbance in depressed patients. To improve these abilities, we decide to manage sleeping in patients. We hypothesized that sleep management reduces cognitive dysfunctions. The results are shown that memory significantly improved by sleep management in experimental group, but nonverbal conceptualization did not show significant difference. According to the literature, the cause of depression is not known, but it can be effectively controlled with treatment. The relationship between sleep and depressive illness is complex - depression may cause sleep problems and sleep problems may cause or contribute to depressive disorders. For some people, symptoms of depression occur before the onset of sleep problems. For others, sleep problems appear first. Sleep problems and depression may also share risk factors and biological features and the two conditions may respond to some of the same treatment strategies. Sleep problems are also associated with more severe depressive illness. To improve cognitive functions in MDD with insomnia, we decide to manage sleeping in patients. We hypothesized that cognitive functions, depression and insomnia will be improve by sleep management. The obtained results are shown that only insomnia and cognitive function (memory) significantly improved by sleep management. However, depression did not shown significant differences. Moreover, we hope, sleep management along with other treatments reduces the possibility of recurrence in depressed patients. It may be difficult to directly transfer the findings from an experimental research to every day situation and using as clinical instruction. Nevertheless, it can be speculated that the findings from the present study may have implications for clinical treatment, rehabilitation and clinical research on pa-

tients with major depression. In a few studies focused on cognitive functions as a problem in depressed patients. In assessing patients, we found that depressed patients with significant cognitive dysfunctions need a longer treatment period than patients without cognitive dysfunctions. Interestingly, we found that cognitive functions correlated with sleep disorder in depressed patients. After treating sleep disorder in depressed patients, their performance improved in assessment. Also, antidepressants affected both sleep disorder and depression. It is suggested that beside antidepressant medication, psychotherapy (focused on sleep management) will be useful in decreasing side effects of drugs.

## 8 CONCLUSION

The aim of the present study was investigating the effect of sleep management on depression, insomnia, and cognitive functions (memory and nonverbal conceptualization). To test the research hypotheses, analysis of covariance was used. The results of covariance analysis for the depression variable were indicated that there is no significant difference between the groups' post-tests on the depression variable ( $P > 0.05$ ). So, the hypothesis is rejected. The effect size is not significant (0.03). The results of covariance analysis for the insomnia variable were shown that there is a statistically significant difference between the groups on the insomnia variable as the groups' post-tests indicate. The effect size, which is an indicator of the impact of the independent variable on the dependent one, is 0.24. The results of covariance analysis for the cognitive functions (memory and nonverbal conceptualization) were shown that there was a significant difference between the groups' post-tests on the memory sub-component ( $P < 0.05$ ). However, the difference was not significant in the case of nonverbal conceptualization ( $P > 0.05$ ). The effect size for the memory and nonverbal conceptualization was 0.30 and 0.01, respectively.

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