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Changes in Bedtime Procrastination and Quality of Sleep of the people with Intellectual Disability through the Application of the White Noise

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ABSTRACT

This study was aimed to provide the basic information about the changes of the bedtime procrastination and sleep quality of the people with intellectual disability through the application of the white noise. The subjects were 14 people with intellectual disability. The white noise was provided for them for an hour before the sleep. Through the application of the white noise, the bedtime procrastination and sleep quality were measured. To measure the bedtime procrastination, the bedtime procrastination scale was used. In the sleep assessment, the Korean Sleep Scale was used to measure the sleep quality and, the total sleep time and wake-up frequency during the sleep was measured as the quantitative index of the sleep quality. The results of the bedtime procrastination showed the decrease continuously after the application of the white noise. The analysis of the sleep, the results of the sleep quality showed improved continuously and the wake-up frequency was decreased and total sleep time was increased continuously. The application of the white noise before the sleep lead the people with intellectual disability to decrease the bedtime procrastination and increase the sleep quality. Thus, this should.

Keywords
Bedtime procrastination, Intellectual disability, Quality of Sleep, White Noise

1. Introduction

Sleep is one of the basic physiological needs and it is crucial for maintaining physical and mental health. Also, sleep effects directly on the performance of the various activities of daily life [1]. It plays a role of restoring and recharging physical and mental health, and sufficient sleep helps an individual to maintain the health and quality of life [2]. However, lack of sleep causes a decrease in appetite and mental problems such as anxiety and depression, causing various troubles in daily life. Moreover, lack of sleep causes obesity and increases the incidence of complications such as diabetes, hypertension, and cardiovascular disease [3]. Therefore, it is very important to maintain properly the adequate sleep and sleep time [4].

The people with the Intellectual disability experience much more various problems in sleep than general people, and this occurs during preparation and sleep process [2]. In preparing or while in sleep, problems such as screaming or moving the body repeatedly are caused by negative reactions to surrounding environment and self-regulation issues [5], delaying sleeping time by watching televisions or sitting in lethargy. As a result, the quality of sleep for them is reduced, and the wake-up frequency during sleep increases, leading to serious health problems. In addition, the performance of the activities of the daily life is decreased due to sleepiness during the day [6], and the issues in wakefulness-control necessary for sleep delays or lengthen sleep time and shift wake-up time forward, which eventually causes reduce in the total sleep time [7]. Therefore, in the various previous studies, the application of white noise has been proposed to induce sleep and improve the quality of sleep for the intellectually disabled [8].

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Among various types of noise, white noise refers to a series of noise that is continuous and have a uniform distribution of frequencies over a wide frequency range of 20-20,000Hz [9]. Cho [10] defined white noise as a noise with constant amplitude within the audible frequency range and a special signal sound used to block ambient sounds. Kim et al. [11] also said that white noise has wide spectra, and that the intensity of a component included in a unit frequency band has a certain characteristic regardless of frequency, and thus has no specific auditory pattern and is regarded as a noise that takes the overall noise level. This include natural sounds such as sounds of rain, waves, and wind, and environmental sounds such as fans and computer noise [9].

White noise plays a role as a blocking sound that reduces surrounding noises by reducing the detection of ambient noise by overwhelming other noises in an irregular and open space. Accordingly, it can help attract the attention of the subjects in the task performance and learning, and it can also improve the performance level and achievement of subjects by improving information processing ability [12]. At the same time, white noise blocks ambient noise, inducing alpha waves in a stable psychological state, significantly reducing beta waves caused by distractions which helps maintaining the generated alpha waves for a long time. Therefore, it can be used to control emotions in daily life and to reduce psychological anxiety of the patients [13].

In particular, white noise is useful as an effective tool of inducing sleep and improving sleep quality among various activities of daily life [10]. During the inducing process, the application of white noise becomes significant in reducing the frequency of arousal by blocking ambient noise that disturbs sleep and reducing auditory immersion. As a result, white noise has a positive effect on reducing the incidence of various behaviors [8] which induces sleep and physical relaxation reducing discomfort during sleep and maintaining sleep in a comfortable state [14]. Moreover, listening to white noise during the process of sleep increases the psychological stability of subjects by blocking ambient noise, thereby inducing deep sleep and effectively improving the sleep quality by increasing the sleeping hours [12].

The studies about the changes of the sleep through the application of the white noise were various. Kim & Kim [8] and Forquer& Johnson [15]'s study was performed for the subjects of the university students, and the Forquer& Johnson [16]'s study was for the toddlers. The studies of the Afshar et al. [17] and Pouya et al. [14] were for the patients admitted to a coronary care. The studies of the Cho [10] and Stanchina et al. [12] were for the hospitalized patients. However, the study for the subjects with intellectual disability was much scarce. Thus, the purpose of the study is to provide the basic information about the changes of the bedtime procrastination and sleep quality of the people with intellectual disability through the application of the white noise.

2. Methods

2.1 Study subjects and period

The study subjects were 14 people with intellectual disability residing in H residential care facility in Y City in Gyeonggi province in South Korea. The criteria of the subjects were as follows: 1) Diagnosis of the intellectual disability based on the DSM-4, 2) No problems of the visual and auditory system, 3) No neurological or physiological problems of the physical structure and function. 4) Not taking the antipsychotic medication.

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Based on the declaration of Helsinki, before the participation in this study, the enough introduction about the purpose and method of this study was provided by the visual material to consider the cognitive level of the people with intellectual disability. For these, the purpose and method of this study was understood enough. After enough understanding this, the people with intellectual disability agreed to voluntary consent. The voluntarily consents of the participation in this study was provided as the paper and also, the paper of the consents from the life rehabilitation teacher was provided to consider the lack of the social interaction and communication skills of the people with intellectual disability. A life rehabilitation teacher cooperated to help them in the process of the consents. The study period was 12 weeks from the June 1 to July 31 in 2017.

2.2 Study procedures

To analysis of the changes of the bedtime procrastination and Sleep quality of the people with intellectual disability, the analysis within group was performed every month. The contents validity index (CVI) was performed to make sure to the validity of the process and methods of this study for the 11 professionals. As the results of the CVI, the validity of the process was 0.89 points and the methods was 0.93. As the obtaining the points over the 0.59 points by the 11 professionals, the results could be considered to be of greater validity [18]. Based on these, this process and methods applied to the subjects.

The application of the white noise was performed in the living room of the subjects by the researcher of this study worked as an occupational therapist with the life rehabilitation teacher cooperated. The assessment of the bedtime procrastination and quality of the sleep was performed by the direct observation of the life rehabilitation teacher. Before the assessment, the enough instruction about the purpose and methods of the assessment was provided to them. The application of the white noise and assessment was performed in the stable environment after the arranging the distracted environment.

2.3 Application of white noise

Based on the Kim & Kim [8]’s study, the white noise was provided as the type of the sound of the rain and running water. These sound was provided for an hour before the sleep by the speaker connecting the mobile phone in the living room. The speaker was positioned directly around the subjects’ head within 30 cm. The intensity of the white noise was set from the 40 to 50dB range which is effective to improve the quality of the sleep based on the Pouya et al. [14] through the modulation of the intensity by the noise detection instrument. Before the process to offer the noise, the distracted environment was arranged and then we blocked the noise outside and close the window and door in the living room to sleep. The subjects were controlled not to drink coffee and alcohol 3 hours before the application of the white noise to minimize the negative effects of the sleep [8].

2.4 Bedtime procrastination assessment

The Bedtime Procrastination Scale (BPS) developed by Kroese et al. [19] was used. The BPS is a useful assessment to measure the activity level to delay the bedtime. The bedtime procrastination

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is an activity by lacking the self-modulation ability, and this means as an activity of the watching TV and wandering around to delay the sleep despite no external event beyond control and expected negative results. The items of the BPS were consisted of the 9 items and each item was measured by the 5 points scale from 1 to 5. The total score of BPS was from 9 to 45 points and the higher total score means a higher level of the bedtime procrastination. The Cronbach's a of the BPS was .92 [19].

2.5 Quality of sleep assessment

The assessment of the quality of the sleep was used by the Korean Sleep Scale (KSS) developed Oh et al. [20]. This is a useful assessment to measure the quality of sleep. In this study, the Sleep type and evaluation and sleep-inducing factors was measured by the KSS. The items of the KSS were consisted of the 15 items and each item was measured by the 4 points scale from 1 to 4. The total score of the KSS was from 15 to 60 points and the higher total score means a higher sleep quality. The Cronbach's a = .783 [21].

Also, the quantitative evaluation of the quality of sleep, based on the Tremaine et al. [22], the total sleep time and wake-up frequency was measured. The measurement of the total sleep time was used by the stopwatch and recorded to be calculated in minutes. The total sleep time was set form bedtime to wake-up time in the morning. The measurement of the wake-up frequency was recorded by the frequency of the wake-up with the activities of the screaming and mumbling, sitting and standing on the bed, walking round in the living room during the sleep [2]. This assessment of the quality of sleep was performed by the direct observation of the life rehabilitation teacher. Before the assessment, the instruction of the purpose and method of the KSS was provided enough to understand. The direct observation by the life rehabilitation teacher was performed in the living room to sleep for the people with intellectual disability and also, the based on the night work manual in the residential care facility, the sleep of the subjects was observed through the regularity patrol.

2.6 Statistical analysis

The collected data was encoded and analyzed using SPSS 23.0 ver. Descriptive statistics was used to analyze the general characteristics and the analysis of the bedtime procrastination, total sleep time, and quality of life was used by the Friedman test. The significant level was set at the 95%.

3. Results

3.1 General characteristics of study subjects

The subjects of this study were 14 people with intellectual disability. As the average age of the subjects, the average age of the male was 22.25 years and the female was 22.76 years. Also, in the sex, 7 males and 7 females were participated. In the disability rating, 7 subjects had 2 level of the disability, and other 7 subjects had 3 level of the disability. In the average height, the male was 165.32 cm and the female was 158.24 cm. In the average weight, the male was 78.43 kg and the female was 58.67 kg (Table 1).

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Table 1. General characteristics of study subjects (n=14)

Characteristics	Classification	Mean±S.D
Age(years)	Male	22.75±2.34
	Female	22.76±2.84
Sex(n, %)	Male	7 (50)
	Female	7 (50)
Disability rating (n, %)	2 grade	7 (50)
	3 grade	7 (50)
Height(cm)	Male	165.32±4.67
	Female	158.24±4.89
Weight(kg)	Male	78.43±3.98
	Female	58.67±3.45

Table 2 Results of bedtime procrastination and quality of sleep

Variables	Pre (Mean±S.D)	1 month after (Mean±S.D)	2 month after (Mean±S.D)	3 month after (Mean±S.D)	X^2	P
Bedtime procrastination (points)	34.08±3.70	29.67±7.23	25.67±5.42	23.25±7.06	10.619	0.012*
Quality of sleep (points)	27.33±5.28	29.67±4.03	33.67±6.72	35.58±6.47	10.449	0.015*
Total sleep time (min)	429.75±47.76	452.08±35.43	468.08±43.98	496.67±40.30	8.345	0.039*
Wake-up frequency during sleep (times)	2.41±1.16	2.17±0.83	2.08±1.00	1.75±0.75	9.380	0.025*

*p<0.05

3.2 The results of bedtime procrastination

As the results of the bedtime procrastination, the average points of the bedtime procrastination were decreased steadily by the 10.83 points and this decrease was statistically significant (p<.0.05) (Table 2). Thus, the application of the white noise effected on the decrease of the bedtime procrastination continuously

3.3 The results of quality of sleep

As the results of the quality of sleep, the average points of the quality of sleep were increased steadily by the 8.25 points and this increase was statistically significant (p<.0.05) (Table 2). Thus, the application of the white noise effected on the increase of the quality of sleep continuously. As the results of the total sleep time, the average time of the total sleep time were increased steadily by the 66.92 min and this increase was statistically significant (p<.0.05) (Table 2). Thus, the application of the white noise effected on the increase of the total sleep time continuously. As the results of the wake-up frequency, the average wake-up frequency were decreased steadily by the 0.66 times and this decrease was statistically significant (p<.0.05)

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(Table 2). Thus, the application of the white noise effected on the decrease of the wake-up frequency.

4. Discussion

Environment is a factor that has a significant impact on human's cognitive processes such as judgment, thinking processes, and even behavior [23]. Among various environmental factors, noise is a crucial factor that directly affects psychological and emotional responses of human beings and it has been considered a physical hazard to decrease the performance levels and healthy life [11]. The unpleasant noise in the daily life causes psychological and emotional anxiety to the people with intellectual disability and even lead to considerable problems in the performance of various areas of activity [6]. Therefore, this study aims to analyze the changes in the bedtime procrastination and the quality of the sleep by applying white noise to them, which can induce psychological stability by blocking ambient noise.As a result, the bedtime procrastination continuously decreased and the quality of sleep improved, increased sleeping time, and the wake-up frequency during sleep was decreased after the application of white noise in the study.

The white noise applied in this study is considered as an effective tool in blocking various noises generated in daily life, inducing psychological stability, inducing sleep, and modifying sleeping time. This is supported by various previous studies. Hyeon et al. [9] reported that the application of white noise enables the subjects to devote attention by blocking external noise and induce psychological stability, which showed more efficacy in reducing the task performance time of subjects than the condition that controlled the noise. Moreover, Kim et al. [11] found that the application of white noise is more effective than the noise-free environment in which noise is removed to induce concentration on tasks, and it facilitated detailed cognitive activities in the ventral tegmentum area and substantia nigra of mid brain, which is effective in evaluating the subjects' sentence comprehension, composition, and numeracy [12].

In the case of the sleep, as the results of the application of the white noise by the study of the Pouya, et al. [14] and Kim & Kim [8], the sleep quality of the experimental group applied in the white noise was higher than that of the control group with no particular treatment or control. Stanchina et al. [12] reported that the arousal level was lower in the sleep when the sound of the intensive care unit was recorded together with the white noise than when only the noise of the intensive care unit was recorded, which indicates that applying white noise reduced alertness and was more effective in sleep induction. Williamson [24] also reported that the application of white noise significantly improved subjects' sleep depth, alertness, return to sleep, sleep quality, and the overall score for sleep. Based on these studies, they were proposed to apply white noise in the sleep preparation and induction process of the people with intellectual disability, and to use environmental sound in the living room for improving psychological stability to enhance activity performance including sleep.

Specifically, as a result of analyzing the bedtime procrastination after applying of white noise, the bedtime procrastination of the subjects was continuously reduced according to the application of white noise. These results are supported by various previous studies. Stanchina et al. [12] found that the application of white noise acts to control the arousal level by increasing the threshold of the subject's noise exposure, thereby inducing psychological stability and reducing the time to fall

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into sleep. Lee & Jung [13] also found that the application of white noise induces the generation of alpha waves occurred in a stable psychological state and maintains the generated alpha waves for a long time so that psychological stability can be sustained. Accordingly, it has shown that the bedtime procrastination is reduced, the time to fall into sleep becomes faster, and the depth of sleep is enhanced. Forquer& Johnson [15] also reported a reduction in the time it takes for subjects to fall asleep after the application of white noise.

Cho [10] reported that the application of white noise reduced the bedtime procrastination compared to the control group wearing earplugs, and it also increased sleep duration through the increase of the sleep efficiency. Based on these studies, the continuous decrease of the bedtime procrastination in this study is evaluated as the result of psychological stability of the subjects induced by continuous application of white noise. Moreover, it results in adjustment in arousal level and reduction in harmful stimuli that cause inappropriate behavioral responses, such as drastically moving their body, and psychological anxiety is continuously reduced due to the application of white noise. The bedtime procrastination is also continuously reduced. Therefore, based on these results, it is proposed to consider the application of white noise to reduce the bedtime procrastination of the people with intellectual disability.

Reduction in the bedtime procrastination during sleep preparation and sleep induction processes increases the overall sleeping time by reducing the gap between preparation and sleep [10]. These results are supported by many previous research results, and psychological stability was induced by the effect of white noise and arousal level was controlled due to the decrease in the bedtime procrastination, leading to increase in overall sleeping time [10, 12, 15]. In the study, white noise is also applied to the subjects, which resulted in a decrease in the bedtime procrastination, resulting in an increase in total sleeping time. The results of this study suggest that the effect of the application of white noise reduces the bedtime procrastination of the subjects and the increase of total sleeping time, and thereby the results have clinical significance, and the application of white noise should be considered and recommended for the increase of total sleeping time.

The frequency of waking during sleep continued to decrease with the decrease of the bedtime procrastination and the increase of total sleeping time according to the application of white noise, leading to enhancement in the quality of sleep. White noise, which can be maintained in the original open space, is effective in relieving tension by continuously providing regular sound wave and blocking various noises generated in the environment to effectively relax the body and to reduce anxiety and tension [25]. Accordingly, white noise effectively acts to stably induce sleep and improve sleep quality [9]. Furthermore, it has a wave length among the brain waves that induces psychological stability and sleep, significantly reducing beta waves caused by distractions and maintaining alpha waves occurring in a stable state for a long time to improve the quality and quantity of sleep. Based on these research, it has been concluded in this study that the enhancement of sleep quality of the people with intellectual disability could be aided by the application of white noise.

These findings are supported by various previous studies. Kim et al. [25] reported that when the sound of ocean waves, which is one of the white noises, is heard by the subjects, particular brain waves were formed which is similar to the brain waves during sound sleep. Moreover, alpha waves generated by white noise stabilized the body and mind of the patients, leading to enhanced quality of sleep. In the study by Afshar et al. [17], white noise before sleep applied to patients

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with coronary artery disease improved sleep quality, and hence supported the results of this study. Kim & Kim [8] also found that the application of white noise to subjects significantly enhanced sleep quality, and that listening to white noise contributed to improving sleep quality as well. Pouya et al. [14] discovered that the application of white noise improved the quality sleep and increased the total sleeping time of patients admitted for cardiovascular treatment, which indicated that white noise is effective in maintaining sleep as an increased sleeping time.

Kim et al. [25] also found that the application of white noise reduced the heart rate in autonomic nervous system responses and increased the respiration, leading to psychological relaxation. Furthermore, when the sensory response is carried out in the central nervous system, alpha waves increase and beta waves decrease according to the application of white noise in the P3 region where brain waves are present, leading to a sensory relaxation. This results in improving sleep quality and induces a deep sleep. Hyun et al. [9] reported that white noise is effective in relaxing the body and reducing anxiety and stress because it has a wave length of brain waves that induces psychological stability and sleep, thereby improving sleep quality. People with intellectual disability are suffering various sleep problems, and due to the poor quality of sleep, learning skills is affected and the performance level of activities is lowered, which causes a significant difficulty in performing daily activities. Therefore, the application of white noise should be considered to improve the quality of sleep of people with intellectual disability.

In this study, the number of subjects was limited due to recruitment of the people with intellectual disability. Accordingly, it would be difficult to generalize the study results, and further research with increased number of subjects is required. Furthermore, the single-subject research design has limitations in comparative analysis between groups with the application of white noise, and it has been considered that it is difficult to estimate the influence of the medium. Therefore, comparative studies between groups with various situations and conditions including white noise should be required in the future for the people with intellectual disability, and an analysis to determine the influence on the quality of sleep should be conducted. Lastly, white noise was provided three times a week, thus in order to compare the effect of white noise according to the frequency of provision, it is necessary to study the effect on the sleep quality through the increase and decrease of the frequency of provision. The analysis of the effects and changes on psychological emotional factors such as psychological stability, stress index, and heart rate should be required in the future.

5. Conclusions

This study was performed to analyze the changes of the bedtime procrastination and sleep quality of the people with intellectual disability through the application of the white noise. After the analysis of the bedtime procrastination and sleep quality, the bedtime procrastination was decreased continuously. Also, in the results of the sleep, the sleep quality was improved and wake-up frequency was decreased and total sleep time was increased continuously after the application of the white noise. The application of the white noise before the sleep lead the people with intellectual disability to decrease the bedtime procrastination and increase the sleep quality. Thus, this should be considered to apply for them in the environment of the sleep preparation.

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