Sleep Stimulation with a smartphone application Nightly: a summary of polysomnography study

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Abstract

In this work we present a summary of clinical study on Sleep Stimulation with a smartphone application Nightly. The study was conducted on a group of 10 healthy people. The main goal of the study was to check whether the Nightly app was safe and did not disturb the sleep architecture. The second outcome was to check how the app influences the sleep efficiency.

1 Introduction

Epidemiological studies show that about 30% of the world's population suffer from sleep disorders with 1/3 of these cases being chronic insomnia [1]. Many scientists assume that insomnia is a natural response to stress and anxiety (according to International Classification of Sleep Disorders). However, this simple adjustment insomnia can easily transform into a chronic one [2]. Listening to soothing music lowers the heart rate, blood pressure, cortisol levels, anxiety and stress [3-8].

During White (1992) study, took part 40 patients after heart attack. The study examined the effects of relaxing music on anxiety. Patients were randomly assigned to an experimental or control group. Experimental group listened to the relaxing music and in this group were found statistically significant reduction in heart rate, respiratory rate and perceived level of anxiety.

In Miluk-Kolasa, Matejek, Stupnicki (1996) study took part 100 in-patients, awaiting non-orthopaedic surgery. Patients were randomly assigned to two groups (50 patients per group): control and music listening. Before the surgery all participants went through measures of blood, pressure, heart rate, skin temperature, glucose count and cardiac output. They were told about the surgical procedure - which was a potent stressor inducing changes in all of above measures. The experimental group listened to music for an hour. In music listening group mean values for all variables returned to initial value, while values for the control group remained at about the stressor-induced levels.

Not only ill patients were tested. During one study [5], 36 subjects were divided randomly into four groups: 2 experimental and 2 control. All subjects were tested individually in a quiet and dimly lighted room and were seated in a comfortable chair throughout the session. In the first experimental group, subject's blood was taken, then he listened through head phones to approximately 15 minutes of music. Following the music, each subject was asked to participate in the "perceived sensory experiences," a task which lasted 15 minutes and was followed with the post-test blood measure. In the second experimental group, the procedure was the same except the post-test blood measure which happened after 24 hours. The first control group was similar to the first experimental group: subject's blood was taken, then he was provided with a variety of magazines in lieu of the experimental treatment for light reading to maintain some degree of alertness. Following the reading, each subject's blood was tested. The second control group did not participate in the music or "perceived sensory experiences" conditions, and were allowed to leave immediately after the pretest venipuncture. Control Group 2 subjects returned 24 hours later for the post-test venipuncture. Blood samples taken before and after treatment were assayed for changes in immune agents interleukin-1 (IL-1) and cortisol. A significant increase in IL-1 was shown in one experimental group; a significant decrease in cortisol was shown in both experimental groups. No significant effects were found in the control groups.

The purpose of another study [6] was to examine the physiological response to different types of music. A group of 20 healthy volunteers were examined by means of pulsed wave Doppler echocardiography, blood sample analysis and psychological testing before and after listening to three different examples of music. Those music examples were: a waltz by J. Strauss, a modern classic by H. W. Henze, and meditative music by R. Shankar. Shankar lowered blood concentrations of cortisol, noradrenaline and tissue plasminogen activator. This may indicate that meditative music lowers activity in the homeostatic system, could also be considered as anxiolytic and could lower stress hormones. Prolactin concentration was significantly decreased after Henze. There was also an improvement of mental state following Strauss which however resulted in an increase of atrial filling fraction.

Studies show that exposure to sounds before going to bed improves the quality of sleep by 35%. Ninety-four students (aged between 19 and 28 years) with sleep complaints were randomly divided into three groups. The study lasted 3 weeks. Group 1 listened for 45 minutes to relaxing classical music, Group 2 listened for 45 minutes to an audiobook, at bedtime for 3 weeks. The control group - Group 3 received no intervention. The sleep quality was measured using the Pittsburg Sleep Quality Index before the study and weekly during the study. Also depressive symptoms were measured with the Beck Depression Inventory. The results were following: music statistically significantly improved sleep quality and decrease depressive symptoms. Neither audiobook nor the control group improve the sleep quality or decrease depressive symptoms. [9]. Scientist proved that insomnia can be treated with music [10].

Nightly's technology is based on scientific research of the past 25 years. Audio and video stimulation before bedtime calms your body and mind, making you well-prepared for falling asleep. Additionally, music played afterwards relieves stress and anxiety making falling asleep more pleasant and smooth. Our Sleep Stimulation is carefully created by sleep scientists, psychologists and experts in the fields of cognitive film theory and neuroaesthetics. Knowing how susceptible the auditory complex is to the music during the sleep [11], we carefully create sound stimuli.

2 Method

The study was performed in a polysomnography laboratory at the Institute of Psychiatry and Neurology. During standard polysomnography recording patients were connected to EEG (Electroencephalography), EOG (Electrooculography), EMG (Electromyography) and ECG (Electrocardiography). A smartphone with the Nightly application was placed in a bed's corner near a pillow. The total number of 10 participants were examined. The selection criteria of participants were as follows: male or female, minimum 18 year-old, not having any sleep problems (declared in an online questionnaire filled in during the screening process). In the first and the second part of the study six participants took part (three in each). In the last part there were four participants, due to the fact that one participant resigned from the study after the first night. The clinical study was divided into three parts, each lasting three nights (summing up to 27 nights).

The first night was without Sleep Stimulation, data gathered during that night was used as a control group in statistical comparisons. During the second and the third one Sleep Stimulation was applied. Nights with Sleep Stimulation consisted of watching a short video played before sleep. Then a short audio stimulation was given at a certain point during the night. After each night participants filled in a questionnaire referring to their well-being, level of regeneration after sleep, mood, remembering their dreams and their description. They also declared (by choosing true or false) whether their sleep was disturbed by any sounds from the application.

3 Hypothesis

The main goal of the study was to check whether the Nightly app is safe and does not disturb the sleep architecture. The second goal was to analyse how the Nightly app influences sleep efficiency and amount of awakenings during sleep.

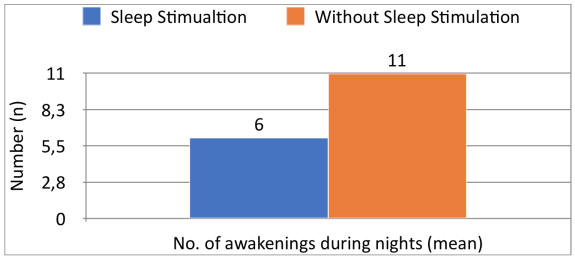

Figure 1: Comparison of nights with Sleep Stimulation and without to the sleep efficiency changes

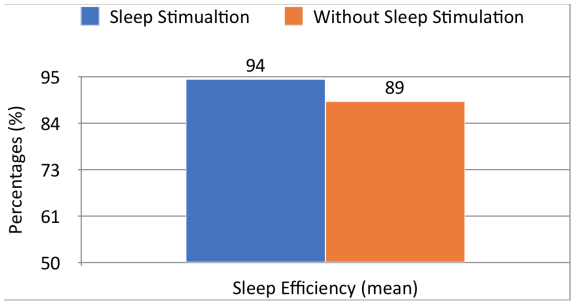

Figure 2: Comparison of nights with Sleep Stimulation and without to the amount of awakenings during a night.

4 Results and statistics

During the study Nightly app was used 27 times: 9 times during the first series, 9 during the second series and 9 during third series. Results from the nights were compared in Twin (a program for analysing polysomnography data) in respect of sleep latency, sleep efficiency, number of awakening during the night and all other medical data. Results significantly different comparing the nights with Sleep Stimulation and without are presented in Fig. 1 and Fig. 2.

4.1 Discussion

Charts clearly show that nights with the Sleep Stimulation significantly improved sleep efficiency and reduced awakenings during nights. There were no other significant changes in such parameters like e.g.: sleep latency, amount of NREM and REM, length of sleep stages, REM latency, arousals during night. This confirms the main hypothesis that Nightly is safe and does not disturbed sleep architecture. The improved sleep efficiency and reduced number of awakenings confirms the second outcome that Nightly app positively affects sleep.

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