Investigating the Efficacy of an EMF Blocking Blanket on Sleep Quality

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Abstract— **Sleep Quality may be affected negatively by continuous electromagnetic fields (EMF) exposure from telecommunication devices, which may further lead to mental health disorders such as anxiety and depression. There are multiple products that claim to block EMF exposure and improve sleep quality. The objective of this study was to have an unbiased quantitative investigation of the efficacy of one such product called "SleepGift" blanket, on sleep quality. A single-blind cross-over study was conducted and the sleep study data of 16 healthy participants, who finished the study, was analyzed. Each participant used real and sham SleepGift blankets for two 10-day study blocks, separated by 30 days of washout period. Sleep data were recorded at pre- and post-intervention of each real and sham block. Sleep quality was assessed using the Odds Ratio Product (ORP) and sleep architecture, along with Electroencephalography (EEG) metrics such as delta power, delta durations and spindles. The results show no significant changes in any of the measured parameters due to using SleepGift real blanket. Given the small samples of this study, a larger data set is recommended to achieve robust conclusion about the efficacy of SleepGift blanket.**
Keywords— **EMF, ORP, EEG**

INTRODUCTION

Telecommunication devices such as cellular phones, laptops, Wi-Fi routers, televisions, microwaves, etc., contribute to ambient invisible electromagnetic field (EMF). A detailed list can be found in the report issued by the World Health Organization (WHO) [1][2]. Increase in EMF exposure has made scientists study the plausible health consequences of EMF. Since nocturnal sleep has homeostatic role being necessary for efficient functioning of cognitive, metabolic, and immune system, the EMF exposure at night may have a more severe impact on health compared to the EMF radiation exposure during daytime [3]. Further, many studies have reported that long term exposure to EMFs can cause significantly poor sleep quality [4]. According to the review conducted in 2015, repeated EMF exposure may alter the REM sleep [5]. Thus, sleep quality might be affected by EMFs emitted from human modern technologies. Multiple studies have been conducted to learn which frequency or wavelength of EMF is leading to more harm, most of which have resulted in further need of investigation to have a robust

conclusion [6]. As poor sleep quality has become an epidemic public health problem for modern societies where some claim the reason being constantly increased EMF exposure [7], there are products, such as the SleepGift blanket that claim blocking 99% of the EMF [8] which might improve one's sleep quality. Thus, this study aimed to investigate the SleepGift blanket's efficacy on sleep quality against a sham blanket in a single blind cross-over study.

METHODOLOGY

Study Design

This study aimed to investigate the efficacy of SleepGift blanket made with silver-infused fabric manufactured and provided by BB Holistic group, on sleep quality in comparison with a regular (sham) blanket of similar size, color and weight (~14 lbs.). A single-blind crossover study was conducted in our Sleep Research Lab at Riverview Health Centre, Winnipeg Manitoba. The study was approved by the Biomedical Research Ethics Board of the University of Manitoba and all participants signed an informed consent prior to be enrolled in the study. Figure 1 shows the flow chart depicting the design of the study. All participants filled in a screening questionnaire which determined their eligibility to participate in the study. The eligibility criteria included being healthy and aged between 18 to 70 years, having no history of psychological or neurological disorders, not using sleeping pills to induce sleep, not using any medicinal or recreational marijuana, and being free from heart or lung diseases. Further, screening questionnaire covered questions about diagnosed sleeping disorders or any other sleeping problems, average sleep time, medical conditions related to heart or lungs, drowsiness during daytime, consumption of any regular prescribed medications and experience with using EMF blocking products. Study participants were randomly assigned into either Group 1 (G1) or Group 2 (G2). G1 participants received a Real blanket in the first block and a Sham blanket in the second block (R1S2), while the order for G2 participants was reversed (S1R2). Participants were kept uninformed about the type of blanket or the group assigned. Both real and sham blankets looked identical and weighed the same.
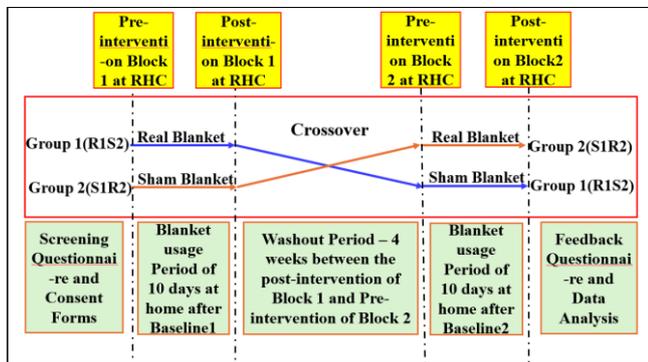
Fig. 1- Design of the study.

Each block included pre- and post-intervention assessments. Participants slept at our Sleep Research Lab using the assigned (real/sham) blanket for block 1 for pre-intervention assessment. After that, they committed to use the assigned blanket at home for the next 10 consecutive nights. Then, they slept in the lab for post-intervention assessment on the 11th night using the same blanket. Participants were advised to go to bed and wake up around the same time while using the blanket at home. The same procedure was repeated for block 2 after a washout period with the order reversed (sham/real) blanket. The washout period was 30 days between the two blocks to avoid residual or carryover effects.

Data Collection

Sleep quality data was recorded using the FDA approved Prodigy head unit provided by Cerebra health. The Prodigy head unit records 2 channels of pre-frontal EEG and Electrooculography (EOG) (Fig. 2). This recorded data was then used to extract features of Odds Ratio Product (ORP), Sleep Architecture and EEG for assessing sleep quality. The ORP features were calculated as the average ORP [9], average ORP for Sleep Stage N2 and average ORP-9. Sleep Architecture features included Sleep Latency, Wake After Sleep Onset (WASO), Arousal Index and Sleep Efficiency. The EEG features included Delta Wave Power, Delta Wave Duration and average Spindle Duration. The Prodigy head unit software provided event files with all the above features' values for each 30 sec epoch of the sleep.

The primary outcome measure of the study was the ORP changes from pre- to post-intervention between the real and sham blocks, while other measures were considered as secondary outcome measures.

ORP is a continuous index for evaluating sleep depth that ranges from 0 (pattern only occurring during deep sleep) to 2.5 (pattern only occurring during wakefulness or in arousal) and the value of ORP is indirectly proportional to the quality of sleep [9]. Lower value of ORP represents better sleep quality and vice-versa. ORP for Sleep Stage N2 represents the sleep quality in deep sleep. ORP-9 assesses the sleep depth after an EEG arousal and is a promising marker of central sleep drive [9].
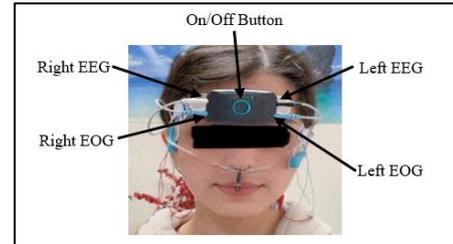

Fig 2- Prodigy Head unit connected to a participant

Sleep latency (SL) is the time until the first epoch of any sleep stage. WASO is Total Recording Time (TRT)-minus-Sleep Latency (SL)-minus-Total Sleep Time (TST). Arousal Index is calculated as the ratio of number of arousals over TST. Sleep Efficiency is calculated as the percentage of TST to the TRT. Delta Power is a measure of the slow-wave activity in EEG, reflecting the depth and restorative quality of sleep. Delta Duration is the total time spent in deep sleep (slow-wave sleep), indicating the quantity of restorative sleep. Spindle duration is the time elapsed between spindle initiation and end. Spindles are interpreted as promoting sleep stability by contrasting potential waking factors arising externally [10].

Data Analysis

Statistical analysis was performed for each block and groups to understand the overall and the treatment effect potentially due to using SleepGift blanket. Each of the sleep recording data included in the analysis was at least 6 hours. All the extracted features were first calculated separately for each of the 4 assessment nights for each participant. Further, post-minus-pre values were calculated and the mean and standard errors (SE) of these values were computed across all participants for each study block in both the groups, as presented in Table 2. Further, the data was tested for both normality and sphericity using Shapiro wilk test and Mauchly's test of sphericity. As most of the features resulted in the violation of normality or sphericity, Wilcoxon Rank test was performed to investigate any significant change between the real and sham pre–interventions for both the groups to check for any carryover effect. Further, for concluding any significant treatment effect or period effect (effect due to the order of the blanket used) between pre- and post-intervention of the real and sham blocks, the Wilcoxon Rank test was conducted for both the groups separately. Any p-value<0.05 was considered significant.

RESULTS AND DISCUSSION

Overall, 25 participants were enrolled, out of which 16 participants completed the study. Table 1 shows their demographic data. The changes in sleep features for Group 1 and Group 2, comparing real and sham post -minus- pre interventions, were calculated for all the features as shown in Table2.

Table 1 - Demographic Data of Participants, N = 16

| Variables	Group 1	Group 2	Total
Total participants	8	8	16
Age (mean ±SD)	41.6±18.7	43.8±18.3	42.7±17.9
Gender (n%)			
Male	5 (62.5%)	5 (62.5%)	10 (62.5%)
Female	3 (37.5%)	3 (37.5%)	6 (37.5%)

Table 2 – Mean ± SE of sleep parameters between real and sham post- minus- pre intervention of both groups.

Features	Group1		Group2	
	Real post - pre	*Sham post - pre*	*Real post - pre*	*Sham post - pre*
Average ORP	-0.06 ± 0.13	0.03 ± 0.10	-0.02 ±0.08	-0.07 ± 0.06
Average ORP N2	0.03 ± 0.05	0.06 ± 0.06	-0.01 ±0.06	0.01 ± 0.03
Average ORP-9	0.01 ± 0.06	0.06 ± 0.07	0.00 ± 0.09	0.00 ± 0.04
Sleep Latency (mins)	0.00 ± 3.84	2.50 ± 10.34	4.62 ± 6.86	16.37 ±8.47
WASO (mins)	-1.39 ± 5.87	-3.16 ± 6.85	-1.57 ±2.66	0.56 ± 2.75
Arousal Index	8.12 ± 25.07	29.75± 28.84	1.50 ±16.75	-23.12±17.49
Sleep Efficiency (%)	4.04 ± 2.10	-2.04 ± 3.29	0.73 ± 1.66	1.03 ± 1.96
Delta Powers (mV^2)	-1.18 ± 5.07	-61.67±83.17	-1.97 ± 7.12	2.30 ± 23.23
Delta Durations (mins)	-9.35 ± 5.53	-6.09 ± 4.87	-1.73 ±5.65	2.82 ± 5.10
Spindle Duration (mins)	-0.47± 1.74	-0.83 ± 2.29	0.26 ±3.18	-1.66 ± 4.09

As can be seen in Table 2, some features showed some improvement (e.g., delta power in Group 2) while others showed no change or variability (e.g., sleep spindles).

The ORP and Sleep parameters comparison in real and sham blocks for groups 1 and 2 are shown in Fig. 3. Positive difference in ORP indicates a decline in sleep quality while negative difference in ORP indicates an improvement in sleep quality. For example, as can be seen in Fig. 3(a), the average ORP of Group1 seems to have some improvement with both real and sham blankets. Further, the Wilcoxon Rank test's results showed no significant difference ($p > 0.05$) or change between the real and sham values of the post -minus- pre intervention in any of the groups and in any of the features. Thus, overall, this study showed no positive or significant effect of the real SleepGift blanket on sleep quality.
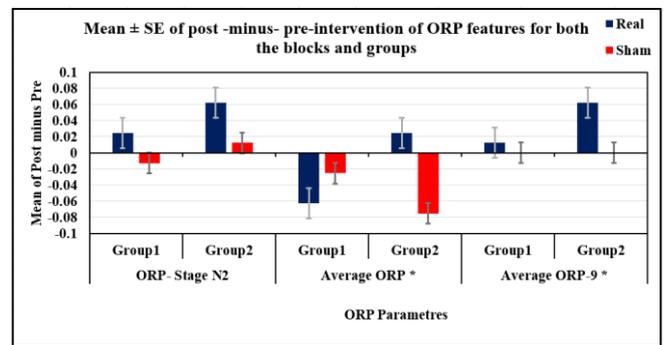
(a) Mean ± SE of ORP parameters
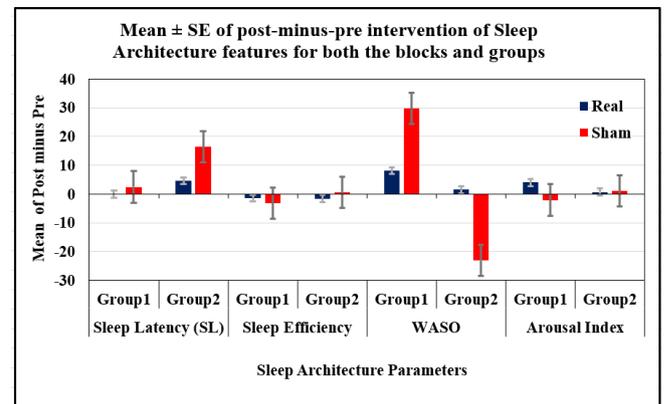
(b) Mean ± SE of Sleep Parameters

Fig. 3 - Plot of Mean of post-minus-pre intervention of real and sham ORP features (a) and Sleep Architecture features (b) for both the groups with standard error bars.

We also measured the magnetic field using a magnetometer (EFA-2 BN 2245 by Wandel & Goltermann) which showed to be 0.2791 µT (micro-Tesla) under the real blanket, 0.3121 µT under the sham blanket and 0.3125 µT in the sleep lab away from the blankets. Given the very small change in EMF blocking of the real blanket, one may not perceive any change in sleep after its usage.

CONCLUSION

The main objective of this study was to have an unbiased investigation of the SleepGift blanket efficacy for mitigating EMF exposure and improving sleep quality. The overall analysis of the data showed no significant improvement in the sleep quality of the participants, and thus no benefit of SleepGift Blanket for sleep quality. It should be noted that there was only one participant who had expressed sensitivity to EMF and did show highly improved sleep quality with the real blanket and remained unchanged with the sham blanket. Perhaps to have a fair conclusion, study participants should be selected from those who claim sensitivity to EMF. Having said that, recruitment of such participants with an objective measurement of such sensitivity is extremely challenging. Nevertheless, without even a known sensitivity to EMF, a larger dataset is needed to reach a robust conclusion about the efficacy of the SleepGift blanket on sleep quality.

LIMITATIONS

While our results are inconclusive for the efficacy of the SleepGift blanket, the study had several limitations that could have affected the results. The small sample size, with only 16 out of 25 participants completing the study, was a significant limitation. Five dropped out because they reported the blanket and the Prodigy head module being heavy and uncomfortable for sleeping, while four did not provide any reason. Also, it was observed that the blanket was too small to fully cover the participants, leaving them partially exposed to EMF. Thus, we recommend reducing the weight and increasing the size of the blanket to completely block the exposure during sleep. Further, even though the blanket claims to block 99% of EMF, the range of EMF protection was not specified. Additionally, the Prodigy head module, which records signals passively, likely added minimal EMF exposure, but since the blanket did not cover the head, it may not have fully reflected changes in sleep quality. Both real and sham blankets were relatively heavy, which may have independently impacted sleep, making it hard to isolate the effects of EMF shielding. Also, limited research on silver fabric's effectiveness for improving sleep adds to these issues. Future studies should test for EMF ranges, verify blanket shielding, consider whole-body coverage, and separate the effects of blanket weight with a larger sample size and EMF sensitive population if possible.

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