CASE REPORT(S)

Cortical Activation Changes Associated with Autonomous Sensory Meridian Response (ASMR): Initial Case Report

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Abstract

The Autonomous Sensory Meridian Response (ASMR) is a unique phenomenon to provoke a sense of relaxation that has been proposed for a few years. This phenomenon suggests acoustic-visual stimuli for cultivating a peaceful environment for the mind as well as a tingling sensation. Some studies suggest that this phenomenon is comparable with mindfulness; surprisingly, published articles in this regard are growing increasingly to examine how it happens scientifically. Some studies have been done on neuroimaging techniques, including functional Magnetic Resonance Imaging (fMRI), biological methods such as heart rate and skin conductance, and questionnaires to assess the impact of ASMR videos. In this paper, we intend to determine the effect of ASMR videos on EEG signals. The FFT absolute power analysis (Pre versus Post ASMR) revealed a declined delta band power generally. On the other hand, there are no significant changes in theta band power. The central region demonstrated a rise in alpha band power as well as a slight decrease in the occipital region. Moreover, such an increase was evident in post-ASMR in the beta1 (Sensorimotor wave (12-15 Hz)) band frequency, generally, especially in the frontal region. Besides, Gamma 1 has been increased in the central region, and Gamma 2 has also be increased in frontoparietal regions in both hemispheres. These results indicate the cognitive process as well as sensorimotor, tingling sensations features of ASMR.

Keywords: Autonomous Sensory Meridian Response; Cortical Activity; Quantitative Electroencephalography; Power Spectra; Case Report.

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1. Introduction

Autonomous Sensory Meridian Response (ASMR), as a perceptual condition, is said to arouse euphoric, deep, relaxing, and pleasurable sensations by triggering stimuli, including hearing whispering or watching someone brush her hair [1-2]. Jennifer Allen, in 2010, invented the term Autonomous Sensory Meridian Response (ASMR) to describe a sensory phenomenon in which specific visual and auditory stimuli consistently trigger tingling sensations on the scalp and neck, sometimes spreading to the back and limbs [2]. It has been compared with auditory-tactile synesthesia and is sometimes called the 'Attention Induced Head Orgasm' [3-4]. However, there was a concern for the ASMR community to bring the term to confuse people's minds towards sexual arousal. It refers to a self-control summit (apex) response. Meridian word was used to express its difference with sexual orgasm [5-6].

ASMR is usually the experience of audio or visual content that is deliberately or accidentally built for this purpose. To engage in ASMR, one must suspend the usual thoughts and worries of life to focus on some triggering scene or stimulus that is essentially meaningless [2].

Recently, ASMR, this exciting phenomenon, has been noticed by the scientific community to review the supporting evidence, mechanism, as well as its performance potential. Today, the ASMR video clips are widely available online, and enthusiasts can select and download any of them to experience some feelings that are evoked during ASMR as a pleasant tingling and eventually feel relaxation. Barratt and Davis indexed several popular ASMR on YouTube; their study identified some common triggers, including whispering (75%), personal attention (69%) and crisp sounds (64%), and slow movements that provoke the ASMR experience in individuals. Data obtained also demonstrates temporary enhancements in symptoms of depression and chronic pain in those who engage in ASMR [1], links between the number of effective triggers and heightened flow state prescribe that flow may be necessary to achieve sensations associated with ASMR. In addition, the researchers have likened the ASMR experience to passive aspects of flow experience like concentration, attendance, and tranquility. Based on this study's data, 98% of participants were employed ASMR for the sake of peace, 82% of the people to improve their sleep, and 70% of them to cope with stress. Poerio *et al.* [7] revealed that ASMR was correlated with decreased heart rate and increased skin conductance levels. Also, an Eye-tracking study [8] indicated that the tingling sensations of ASMR could cause significant increases in pupil diameter, statistically. These results are confirming that they have physiological roots. As a result, ASMR could be a reliable and physiologically-rooted experience that may have healing advantages mentally and physically.

The research was investigated the neural circuitry involved in ASMR for the first time. Their results determined a significantly minor (less) connectivity in the Default Mode Network (DMN) in the experimental group compared with the control group. In this regard, the authors suspect that reduced DMN connectivity may be regarded as a biomarker for an unusual neurological function. Besides, subjects with ASMR revealed increased DMN functional connectivity than controls in some regions of the cortex (occipital, frontal, and temporal cortices), which are naturally related to executive control and visual resting-state networks. This unusual functional connectivity may affect special ASMR experiences [9]. Notwithstanding, this study did not discover any proof that specific ASMR triggers are associated with the special default mode network activity. The study, which used functional Magnetic Resonance Imaging (fMRI), concluded that there were significant differences in the DMN of individuals who have ASMR as compared to a control group without ASMR. More currently, Smith *et al.* [10] examine the relationships between the types of ASMR triggers and intensity of elicited ASMR and resting-state functional connectivity. The data revealed that whispering was the most intense trigger, also tapping noises were the next most intense trigger. Supplementary analyses proved that touching and mouth sounds positively correlated with dorsal attention, Frontoparietal, as well as Sensorimotor Networks. Moreover, evidence shows that ASMR may be associated with certain personality attributes. A recent investigation found that features such as openness to new experiences and neuroticism, and the less significant levels of conscientiousness, extraversion, and agreeableness in 290 people with ASMR compared with peers in the control group [11]. In our previous research [12], we compared the perception of time among music and ASMR; the results showed that both of them have

the same impression on time perception. A recent fMRI study [13] revealed that ASMR is mainly involved in mentalizing and self-referential processing. The results also showed that ASMR triggers could weaken visual information processing in response to high arousal states. When we started working on this project, there was no EEG studies on ASMR phenomena. The first article in this field was published by Beverley Katherine Fredborg in January 2021 [14]. They use 32-channel EEG to investigate brain activities on fourteen participants who experienced ASMR and fourteen control ones. The findings revealed that ASMR stimuli elicited frontal-lobe alpha wave activity as well as EEG frequency bands associated with movement in ASMR-experienced participants. In addition, ASMR results indicate the attentional and sensorimotor (12-15Hz) phenomenology of ASMR. One of the limitations of this study would be the "button-press" problem for the ASMR group. When the participant press the button, it could lead to undesirable Ronadic-Beta rhythms or Mu rhythms in the ASMR group. In this study, we aimed to investigate the brain activity changes of four-year experienced before and after watching the ASMR video.

2. Materials and Methods

Our case study was done on a 30-year old right-handed female who has the experience of ASMR for four years continuously. She has no history of any neurologic disease, psychiatric disorders, substance abuse, or hearing problems. Also, she was not under the effect of any medicine or stimulant food or drink. The subject read and signed the informed consent to take part in the study. She reported watching ASMR videos four to five times a week before sleep in these four years. Additionally, she expressed her ASMR experience as a relaxing sensation coupled with drowsiness in the flow state.

To make the desired ASMR video, we used a combination of the most popular ASMR videos on YouTube. Thus, the most effective ASMR triggers, such as whispering, scratching and tapping, eating sounds, smiling, and personal attention have been selected from the most famous ASMRtists, including Gentle Whispering, Whispers Unicorn, ASMR Darling, and Gibi ASMR.

The participant watched this video in the quiet room for 20 minutes with a high-quality headphone (The participant has good knowledge of English in all skills). A 19- channel ear links EEG montage using a 32-channel amplifier system (202, Mister Company, Russia) was used for QEEG data acquisition. The channel dipoles, based on the international 10-20 system, included Fp_1, Fp_2, F_3, F_4, C_3, C_4, p_3 ,P_4 ,O_1 ,O_2-AA, F_7, F_8, T_3, T_4, T_5, T_6, F_z, C_z, P_z where FP stands for front polar, C for central, F for frontal, P for parietal, T for temporal and O for occipital. For the resting-state condition, the subject was sat in a comfortable chair in the recording room.

The resting-state EEG recording continued for 10 minutes (as Pre-ASMR). After that, the subject watched the mentioned ASMR video for 20 minutes as well. Immediately after finishing the video, EEG recording continued for 10 minutes, the same as resting-state as the post-ASMR step. All raw EEG signals were imported into WinEEG software. Afterward, for the purpose of analysis, we used commercially available NeuroGuide (v.2.9.0, Applied Neuroscience, USA) software. Firstly, provided signals were sampled at 256 Hz. Following this, we used automatic artifact rejection, including Z score threshold=2 as well as high sensitivity Drowsiness, eye movement, and muscle artifact rejection.

With the completion of these steps, as outlined before, the NeuroGuide software was used to analyze and plot the topographic maps coupled with the power spectra of the EEG activity during both pre and post-ASMR sessions.

3. Results

The FFT absolute power analysis revealed a declined delta band power generally, in particular, in the right frontal region (FP_2) in post-ASMR versus resting states. On the other hand, there are no significant changes in theta band power, although there is a slight decrease in the occipital region (O_1). According to the results, the central region (C_z) demonstrated a rise in alpha band power as well as a slight decrease in the occipital region (O_1,O_2). Moreover, such an increase was evident in post-ASMR in the beta band frequency in general, especially in the frontal (F_3, F_4) region. Likewise, there is an increase in beta1 (T_3, F_3), beta 2 (T_3), beta 3(T3), and high beta (FP_2). Gamma 1 has been increased in post-ASMR versus Per-ASMR in the central region.

Besides, Gamma 2 has also be increased in frontoparietal regions in both hemispheres (Figure 1).

In terms of the FFT power ratio (Figure 2), left occipital-parietal, mainly left frontal regions, illustrated a rise in the delta/theta power ratio; on the contrary, the decrease was evident in the right frontal region.

Besides, in frontal regions in both hemispheres, there is an increase in theta/alpha power ratio as well as theta/beta power ratio in the left frontal and right occipital regions. The statistical data are being shown in Table 1.

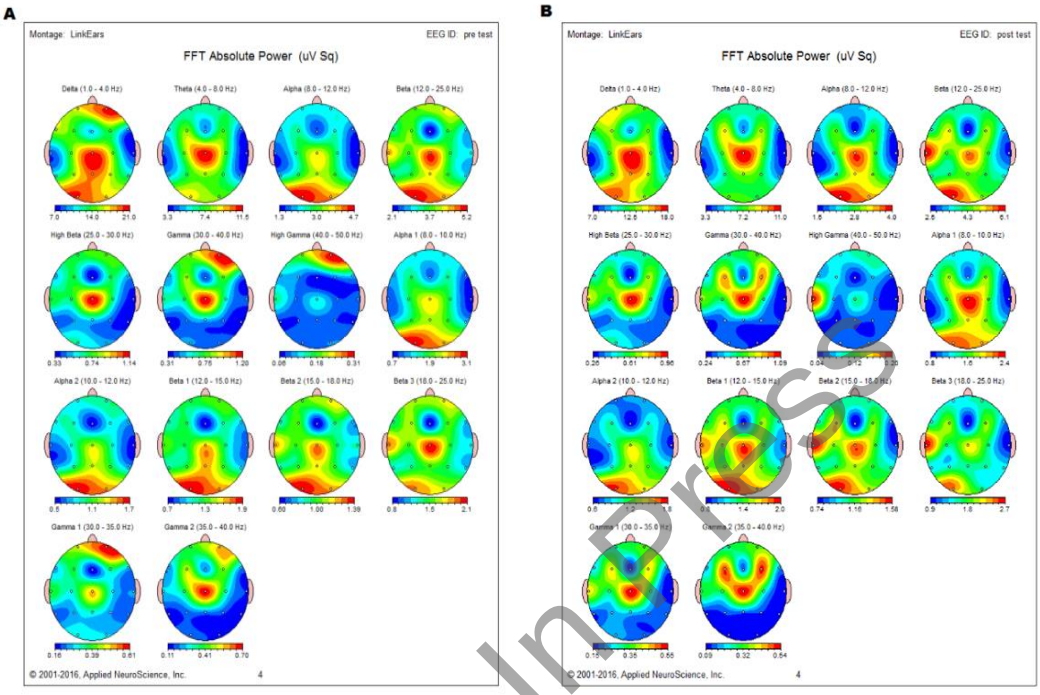

Figure 1. The QEEG topographical spectral brain maps. (A): The analysis demonstrates FFT absolute power values across spectra upon resting state and (B): Post-ASMR FFT absolute power upon post-ASMR data

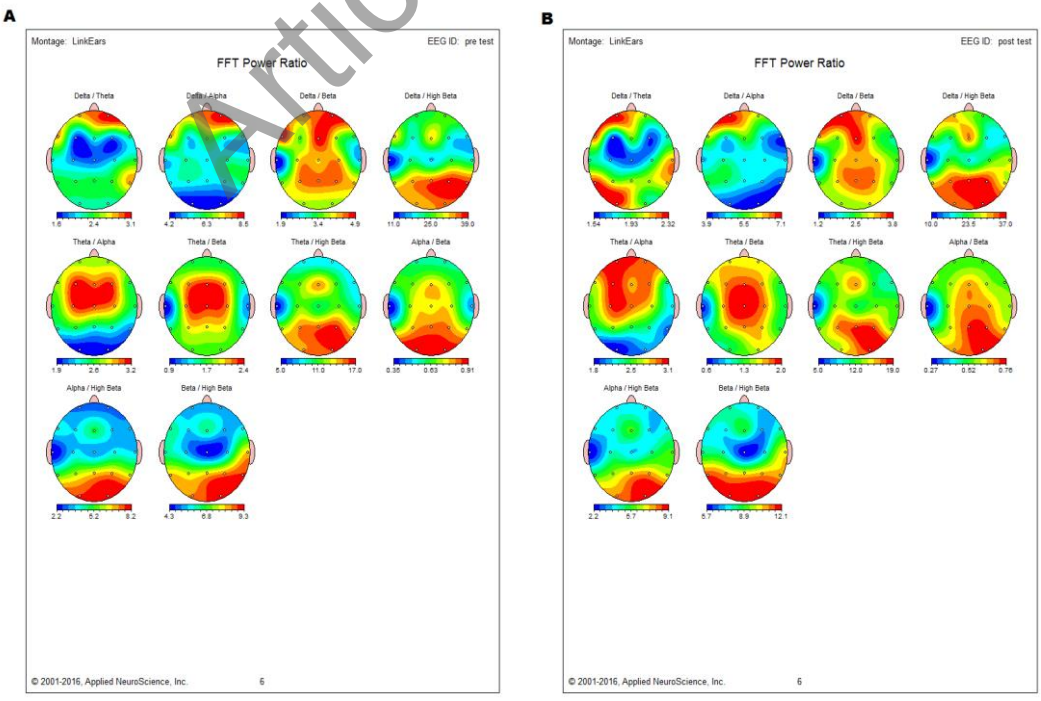

Figure2. The QEEG topographical spectral brain maps. (A): The analysis demonstrates FFT power ratio values across spectra upon resting state and (B): Post-ASMR power ratio upon post-ASMR data

Table 1. The statistical data of FFT absolute power in each frequency band before and after watching ASMR video

FFT Absolute Power	Mean±SD	Max	Min
Pre-Delta	14.75	20.27	7.60
Post-Delta	12.40	17.75	7.28
Pre-Theta	6.70	11.43	3.31
Post-Theta	6.44	10.97	3.37
Pre-Alpha	2.56	1.55	4.44
Post-Alpha	2.66	1.35	4.68
Pre-Beta	4.22	2.74	5.91
Post-Beta	3.73	2.13	5.16
Pre-Beta1	1.27	1.89	0.71
Post-Beta1	1.47	1.99	0.88
Pre-Beta2	1.00	1.38	0.60
Post-Beta2	1.16	1.57	0.74
Pre-Beta3	1.46	2.05	0.83
Post-Beta3	1.63	2.62	0.94
Pre-High Beta	0.58	1.14	0.33
Post-High Beta	0.49	0.95	0.27

Besides, Figure 3 illustrates the FFT absolute power of each frequency band before and after watching ASMR video.

4. Discussion

In this paper, we intended to investigate cortical activities before and after watching ASMR videos. As the results revealed, there are some variations in the delta, alpha, and beta power cortical activity in pre-ASMR versus Post- ASMR. It should be noted that, since there is no QEEG study regarding ASMR (Except [14]), most of the papers compare it with mindfulness or meditation. The patterns of increased alpha and theta amplitude correlated with meditation were observed in both experienced and novice meditators. In other words, alpha synchronization has been regarded as one of the 'signatures' of meditation [15]. According to the results of this paper, there is a significant alpha increase, mainly in the central region, which is similar to the mentioned related findings. Studies of the significance of beta are complicated owing to it has been proposed to reflect a decline in cortical activity as it is associated with barbiturates, as well as benzodiazepines, used the terms of beta oscillations, the beta amplitude was higher in meditation particularly experienced meditators [16]. This finding seems very resembling in our findings in the post-ASMR stage as well. Slow-wave delta band activity is more generally connected with sleep, especially during deep non-REM stages. Nevertheless, fewer investigations have reported delta activity during or after meditation or mindfulness. It has been suggested, though, that an increase in delta activity during wakefulness shows the attention to internal processing through the performance of cognitive tasks, including difficult arithmetical calculation tasks. The reports of delta activity have commonly found no differences [17]. According to our results, there is a decline in delta power in post-ASMR versus per-ASMR, which may be rooted in the reduction of mind wandering or complicated internal processing after watching ASMR videos. Compared with the only EEG study [14] on ASMR, Gamma wave activities were increased in both studies, mostly associated with the tingling sensations. Also, in sensorimotor waves (12-15 Hz), the increase has been shown. On the other hand, this study's alpha activity is increased in the central and occipital regions, mostly contributing to visual and cognitive processes. While in that article, it is mainly seen in the frontal area.

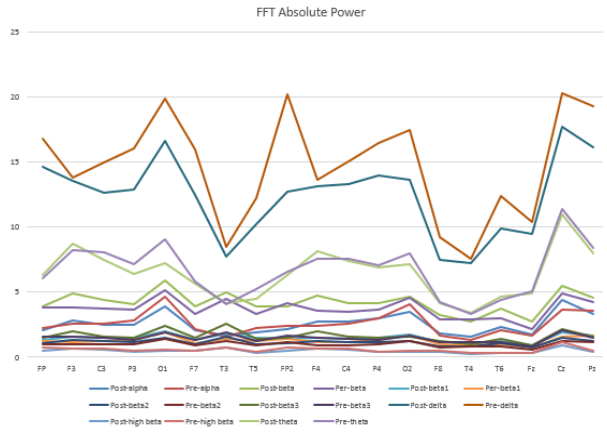

Figure 3. The line chart of FFT absolute power of each frequency band before and after watching the ASMR video

5. Limitation

Although the current study presents novel information about the EEG changes after the ASMR experience, there are some limitations. The recent research recruited one experienced-participant because we do not have access to more experienced-participant; without any doubt, a larger sample size would improve these analyses' strength. Another limitation would be the lack of EEG studies for comparison of our results. As future work, we aim to mixed-use of high-level technological devices, including functional near-infrared spectroscopy (fNIRS), Functional Magnetic Resonance Imaging (fMRI), and Magnetoencephalography (MEG) would suggest novel possibilities for more in-depth research of the above.

6. Conclusion

To conclude, this study indicated almost identical results comparing the recent EEG investigations of the ASMR study. Our results showed the FFT absolute power analysis (Pre versus Post ASMR) and revealed a declined delta band power generally. On the other hand, there are no significant changes in theta band power. The central region demonstrated a rise in alpha band power as well as a slight decrease in the occipital region. Moreover, such an increase was evident in post-ASMR in the beta band frequency, generally, especially in the frontal area. Likewise, there is an increase in beta1 (Sensorimotor wave), beta 2, beta 3 and high beta. Gamma 1 has been increased in the central region, and Gamma 2 has also been raised in the frontoparietal areas in both hemispheres. These results show the cognitive process, sensorimotor, and tingling sensations characteristics of ASMR. Possibly, ASMR could be remarkable examples that may demonstrate therapeutically promoting personal well-being or happiness.

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