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Effect of Meditation on Galvanic Skin Response

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ABSTRACT

Background: Meditation is a mental practice in which a person intentionally focuses their mind on a particular object, thought, sensation or awareness to cultivate calmness, clarity, emotional balance and heightened consciousness. Meditation significantly influences the autonomic nervous system by reducing sympathetic activity and enhancing parasympathetic activity.
Aim: The present study was conducted to find out the effect of regular meditation practice on galvanic skin response (GSR) in apparently healthy medical undergraduates.
Methodology: An experimental study was conducted in the Department of Physiology on 50 apparently healthy MBBS student volunteers aged 18- 25 years. Baseline GSR recordings were obtained prior to the meditation sessions. The meditation sessions were kept for 20 minutes a day, five times a week for three months. GSR recordings were again taken after the completion of the three months meditation program. The pre & post- intervention values of GSR were compared using the Wilcoxon Signed- rank test.
Result: A statistically significant increase in GSR was observed in the participants after three months of regular meditation sessions. The median interquartile range (IQR) of GSR increased from 267.5 to 534.5 with a p- value of < 0.001.
Conclusion: Regular meditation practice for three months resulted in a significant increase in galvanic skin response (GSR) in apparently healthy young individuals. Therefore, meditation can be used as an effective method to promote relaxation and reduce stress and anxiety.

Keywords: Meditation, galvanic skin response, electro dermal response, skin conductance

INTRODUCTION

Meditation is a well-organized mental practice in which attention is consciously directed inward, away from external distractions, thereby strengthening the integration of mind, body and spirit [1]. It can be practiced through multiple techniques such as contemplation, focused concentration, listening to nature sounds, guided meditation, controlled breathing and mantra repetition.[2,3,4] Meditation is known to modulate bodily functions through the autonomic nervous system by enhancing parasympathetic activity and this shift promotes a state of relaxation and calmness.[2,3,4] It has been associated with reduced blood pressure, heart rate, lactate, cortisol and epinephrine levels and also leads to a decrease in metabolism, respiratory rate, oxygen consumption and carbon dioxide elimination[5,6,7,8] . At the same time, meditation contributes to increased melatonin and dehydroepiandrosterone sulfate (DHEA-S)

levels, along with improvement of skin resistance/ response and enhanced relative cerebral blood flow. [5,6,7]

Galvanic skin response (GSR) is a sensitive physiological marker that reflects changes in skin resistance, largely dependent on eccrine sweat gland activity. But despite its relevance as an indicator of autonomic and sympathetic arousal, studies evaluating the influence of meditation on GSR are limited and evidence among medical students is particularly scarce. Therefore, the present study aims to evaluate the effect of meditation on GSR levels in medical undergraduates by comparing baseline GSR values with those obtained after three months of regular meditation practice.

Aim & Objective: The present study was conducted to find out the effect of three months regular meditation practice on galvanic skin response (GSR) in apparently healthy medical undergraduates.

MATERIALS & METHODOLOGY

Place of study: Government Medical College, Miraj, Maharashtra, India

Setting of Study: Department of Physiology

Study type: Experimental study

Duration of study: 6 months (February 2023 to July 2023)

Study population: 50 MBBS student volunteers in the age group of 18-25 years studying in 1st to 3rd year MBBS of the institute.

Inclusion criteria: Apparently healthy student volunteers in the age group of 18-25 years of either gender.

Exclusion criteria:

- Students with history of any systemic illness or who had undergone any major surgeries.
- Students who had practised regular yoga or meditation previously.

Informed consents were obtained from the participants.

GSR was measured using the Digital Polygraph-Physiograph (Medicaid Systems) available in the department. The GSR values can vary with time of the day, temperature or anxiety. So, all the recordings were taken in the evening in a quiet room. To ensure accuracy, the participants were made to rest for 10 minutes before measurement and the recordings were taken in a relaxed sitting position. Two electrodes were attached to the distal phalanges of the index and middle fingers of the dominant hand. After achieving normal, relaxed breathing, GSR was recorded for 3 minutes, with instructions to remain still and avoid movement or talking. The average of three readings was taken as the final GSR value for each participant.

Meditation training was guided by a trainer for the first 3 days, and then continued using a 20-minute pre-recorded audio which included 10 minutes of pranayama (Bhastrika, Anulom Vyom & Kapalbati) and Om chanting for relaxation. The participants were instructed to sit in a comfortable meditative posture during the meditation sessions. The sessions were conducted after 5 pm, five days a week for three months, in a dim-lit room in the Physiology department.

GSR measurements were repeated after the three months of regular meditation sessions.

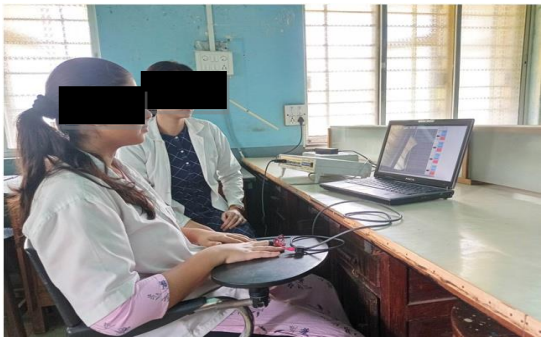

Figure 1: Recording of galvanic skin response using the digital polygraph- physiograph

Figure 2: Digital polygraph- physiograph (Medicaid Systems)

Statistical Analysis

Statistical analysis was carried out using Statistical Package of the Social Sciences version 21 (SPSS for Windows, version 21.0, SPSS Inc, Chicago, USA)

The variables were not normally distributed. Hence, Wilcoxon signed rank test was used for the comparison of GSR before and after the meditation. A statistically significant increase in GSR was observed in the participants after three months of regular meditation sessions. The median interquartile range (IQR) of GSR increased from 267.5 to 534.5 with a p-value of < 0.001

RESULT

Table 1. Comparison of the galvanic skin response (GSR) of the study participants before and after meditation (N= 50)

Variable	Before Meditation, Median (IQR)	After Meditation, Median (IQR)	p-value
GSR (kilo-ohm)	267.5 (191.7-389.5)	534.5(386.6-686.1)	<0.001

Wilcoxon signed rank test

Table 1 shows that there was significant increase in the galvanic skin response of the study participants after the intervention-meditation (p<0.001).

A statistically significant increase in GSR was observed in the participants after three months of regular meditation sessions. The median interquartile range (IQR) of GSR increased from 267.5 to 534.5 with a p-value of < 0.001

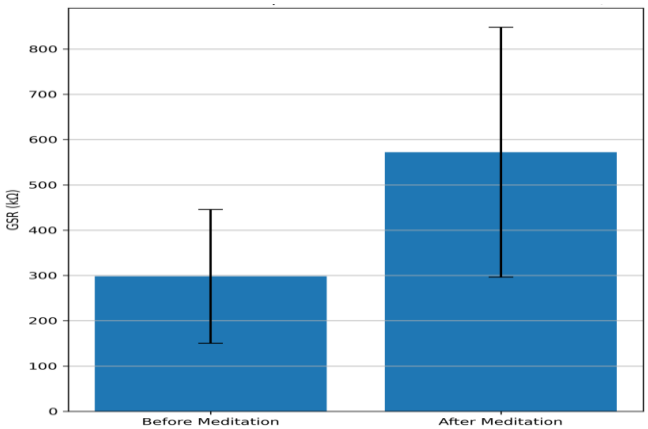

Figure 3: Median GSR values before & after meditation

Figure 3 shows the comparison of the median GSR values before and after the intervention (meditation). A significant increase in the median GSR of the participants (N=50) is observed.

DISCUSSION

The study resulted in a significant increase in galvanic skin response (GSR) among the participants ($p < 0.001$). This indicates a shift in autonomic balance towards enhanced parasympathetic activity. GSR is an important physiological marker of autonomic nervous function and reflects sweat gland activity. [9]

When sympathetic activity increases, sweat gland secretion rises, leading to higher skin moisture. It is known that sweat contains electrolytes such as sodium, chloride & potassium ions which are good conductors of electricity. Therefore, higher sweat production & skin moisture leads to improved electrical conductivity, which lowers the skin resistance.[9] On the other hand, parasympathetic activity decreases sweating, resulting in increased skin resistance. The observed rise in the galvanic skin response following regular meditation suggests parasympathetic dominance and improved autonomic stability. The current result is in agreement with the findings from previous studies. [10,11, 12]

One of the primary mechanisms of this effect is the reduction in sympathetic nervous activity. Meditation promotes a calm mental state and reduces the "fight & flight" response associated with stress, anxiety and heightened physiological arousal. With regular meditation practice, it is seen that parasympathetic activity becomes more prominent. This shift leads to reduced eccrine sweat glands activity, decreased sweat production and consequently increased skin resistance. [13]

It is also known that meditation induces relaxation response with reductions in heart rate, blood pressure, respiratory rate and muscle tension. As the emotional and physiological arousals are diminished, sweat gland activity also declines, leading to increase in skin resistance. Previous studies have also reported that relaxed states, including meditation and sleep are associated with increased skin resistance and reduced skin conductance. [14]

Neuroendocrine changes may also play a role in this effect. Meditation has been associated with increased beta- endorphin release, which promotes a sense of well-being and inhibits the hypothalamic-pituitary-adrenal axis. Consequently, cortisol levels also decline. [15, 16]

It is well known that elevated cortisol is linked to increased sympathetic activity and sweating, its reduction may lead to decrease in sweat gland activity and hence increased skin resistance. Hence, meditation appears to enhance autonomic stability by reducing sympathetic overactivity, promoting parasympathetic dominance, lowering physiological stress and modulating stress-related hormonal responses. [13,14,15,16]

These effects result in decreased sweating, reduced skin conductance and a significant increase in galvanic skin response.

Hence, a regular practice of meditation can increase GSR in medical students, which indicates increased parasympathetic dominance and better autonomic balance, which can help decrease stress, improve well- being, enhance cognition and reduce burnout.

CONCLUSION

The study aimed to find out the effect of meditation on galvanic skin response (GSR) among medical undergraduates. We have found a statistically significant increase in GSR after three months of regular meditation. So, a regular practice of meditation even for a short period of three months can lead to improvement in autonomic function. Hence, it is an effective method for improving autonomic balance, relaxation, cognition and for reducing stress & anxiety. This can be very useful for the medical students since they are usually in a lot of stress. Moreover, meditation can be a safe, effective and complementary therapeutic approach for people prone to stress, anxiety and depression. It can be used as a preventive therapy as well as an adjunct to pharmacological and psychological therapies.

Declaration By Authors

Ethical Approval: The research was approved by the Institutional Ethics Committee of Government Medical College & Hospital, Miraj & PVPGH, Sangli, approval number GMCM/IEC-C8/2022, dated 07/09/2022

Declaration of participant consent: The authors certify that they have obtained all appropriate participant consent.

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Conflict of Interest: The authors declare no conflict of interest.

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