ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Effectiveness of 20 weeks of non-invasive electrical vestibular nerve stimulation in the management of obesity in adolescents

Nithiya K[1], Vinothini M[2], Deepan Suresh V[3], Sai Sailesh Kumar Goothy[4]

[1]Assistant Professor, Department of Paediatrics, Arupadaiveedu Medical College and Hospital, Pondicherry, [2]Assistant Professor, Department of Pediatrics, Arunai Medical College and Hospital, [3]Assistant Professor, Department of General Medicine, Government Tiruvannamalai Medical College and Hospital, Tiruvannamalai, Tamil Nadu, [4]Professor, Department of Physiology, NRI Institute of Medical Sciences, Visakhapatnam, Andhra Pradesh, India

Submission: 31-01-2025 Revision: 06-02-2025 Publication: 01-03-2025

ABSTRACT

Background: The number of cases of obesity has been rising worldwide due to the current lifestyle and unhealthy food habits. The vestibular system has connections with various brain areas involved in the regulation of food intake. Stimulating the vestibular system by non-invasive means has multiple benefits. However, the studies in this area are relatively less. Hence, the present study was undertaken. **Aims and Objectives:** The present study was undertaken to observe the effectiveness of non-invasive electrical vestibular nerve stimulation in the management of obesity. **Materials and Methods:** The present study was an experimental study where a total of 30 male and female participants were part of the study. After recording the baseline values, participants underwent non-invasive electrical vestibular nerve stimulation for 20 weeks. Post-intervention values were recorded after completion of 20 weeks. Body weight was recorded using a digital weighing machine cult smart scale. Body mass index (BMI) was calculated using a BMI calculator available online. Eating behavior was assessed using a standard questionnaire Eating Attitude Test 26 (EAT-26). **Results:** There was a significant decrease in the body weight, BMI and EAT-26 score followed by the 20 weeks of intervention in both males and females. No serious adverse effects were noted. **Conclusion:** The current study results support the implementation of non-invasive electrical vestibular nerve stimulation in combination with a lacto-vegetarian diet in the management of obesity. Further, the study presents that non-invasive electrical vestibular nerve stimulation is safe to use in a long-term basis.

Key words: Obesity; Alternative therapies; Vestibular system; Lacto-vegetarian diet

Access this article online

Website: https://ajmsjournal.info/index.php/AJMS/index

DOI: 10.71152/ajms.v16i3.4436

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Excessive accumulation of fat in the body leads to obesity, which is aserious public health issue throughout the world. Obesity is associated with various non-communicable disorders, such as diabetes mellitus, cardiovascular disorders, and metabolic disorders. The number of cases of obesity has been rising worldwide due to the current lifestyle and unhealthy food habits.[1] The body mass index (BMI) is used to identify obesity. A BMI of 30 kg/m^2 or higher indicates obesity. Energy imbalance for a long duration leads to obesity.[2] As obesity is associated with multiple disorders, it has to be managed effectively. Anti-obesity medications, surgical interventions, and lifestyle interventions are the available management strategies for obesity. However, pharmacological interventions are associated with potential side effects if used for a long-term basis.[3] The hypothalamus plays a key role in the

Address for Correspondence:
Dr. Vinothini M, Assistant Professor, Department of Pediatrics, Arunai Medical College and Hospital, Tiruvannamalai, Tamil Nadu, India.
Mobile: +91-9486146834. **E-mail:** vino.sumu@gmail.com

management of metabolic homeostasis. The vestibular system. The sixth sense was reported to influence the hypothalamus and reduce the storage of fat.[4] Interestingly, dysregulation of the vestibular system leads to impairment of the glucose metabolism and is associated with obesity. It was reported that the vestibular system regulates the set points related to the energy balance.[5] Further, the secretion of insulin is also influenced by vestibular stimulation through the modulation of autonomic activity. That is stimulating the vagal activity and inhibiting the sympathetic discharge.[6] Animal study presented a significant decrease in the body weight and total cholesterol in hyperlipidemia animals followed by caloric vestibular stimulation.[7] The vestibular system has connections with various brain areas involved in the regulation of food intake.[8] Stimulating the vestibular system by non-invasive means has multiple benefits. However, the studies in this area are relatively less. Hence, the present study was undertaken.

Aim and objectives

The present study was undertaken to observe the effectiveness of non-invasive electrical vestibular nerve stimulation in the management of obesity.

MATERIALS AND METHODS

The present study was an experimental study where a total of 30 male and female participants were part of the study. The study protocol was approved by the institutional human ethics committee (IHEC/28/6/88). The participants acted as self-control. Informed consent was obtained from all the participants before the study. After recording the baseline values, participants underwent non-invasive electrical vestibular nerve stimulation for 20 weeks. Post-intervention values were recorded after completion of 20 weeks. All the participants followed a strict lacto-vegetarian diet that is plant-based food and dairy products during the study period. Willing participants, aged above 18 years and with a BMI of 30–40 kg/m^2 were included in the study. Participants who were currently using any interventions including the use of oral contraceptives or dietary supplements known to affect the BMI, with ear disorders (assessed during physical examination), and any other severe health complications were excluded from the study. After recruitment, all the participants underwent a general physical examination and their demographic data and BMI. Body weight was recorded using a digital weighing machine cult smart scale. BMI was calculated using the BMI calculator available online. Eating behavior was assessed using a standard questionnaire Eating Attitude Test 26 (EAT-26).[9] Bilateral electrical VeNs was administered using a battery-powered vestibular nerve stimulator (ML 1000, Neurovalens, UK) (Figure 1).[10] The device offers 10 levels of stimulation. As the device s switched on it provides level 1 of stimulation. The participant can increase the levels until he feels comfortable and decides his comfortable level of stimulation. An increase and decrease in the levels of stimulation can be done manually with the buttons provided on the device. This level is subjective and varies from person to person. The total duration of the intervention is 20 weeks with 5 sessions per week. Each session is for 1 h duration. The participants visited the obesity clinic at their convenient time and underwent the intervention. Participants were asked to report adverse events if any they experienced during the study.

Statistical analysis

Data were analyzed using SPSS 22.0. Student t-test was applied to observe the significance of the difference between the pre- and post-intervention values. A probability value <0.05 was considered as significant.

RESULTS

A total of 15 males and 15 females are part of the study. Baseline body weight is more in males when compared to females (Table 1). There was a significant decrease in the body weight, BMI, and EAT-26 score followed by the 20 weeks of intervention in both males and females (Tables 2-4). No serious adverse effects were noted.

Figure 1: Non-invasive electrical vestibular nerve stimulator

Table 1: Comparison of demographic data and EAT-26 score of the participants prior to the study

Parameter	Males (n=15)	Females (n=15)	P-value
Age (years)	47.87±8.85	51.73±9.32	0.2540
Height (cm)	174.4±5.03	162.07±3.06	0.0001***
Weight (kg)	103.07±5.31	90.73±4.17	0.0001***
BMI (kg/m^2)	33.9±1.04	34.53±0.87	0.0816
EAT-26 score	27.07±0.88	26.80±0.77	0.3870

Data were expressed as mean and SD. (***P<0.001 is significant). EAT-26: Eating attitude test 26, BMI: Body mass index

Table 2: Body weight, BMI, and EAT-26 score before and after 20 weeks of non-invasive electrical vestibular nerve stimulation in the study participants

Parameter	Before (n=15)	After (n=15)	P-value
Weight (kg)	96.90±7.83	87.50±7.76	0.0001***
BMI (kg/m^2)	34.21±0.997	30.86±0.933	0.0001***
EAT-26 score	26.93±0.83	22.93±1.01	0.0001***

Data were expressed as mean and SD. (***P<0.001 is significant). EAT-26: Eating attitude test 26, BMI: Body mass index

Table 3: Comparison of body weight, BMI, and EAT-26 score before and after 20 weeks of non-invasive electrical vestibular nerve stimulation in males

Parameter	Before (n=15)	After (n=15)	P-value
Weight (kg)	103.07±5.31	93.87±4.78	0.0001***
BMI (kg/m^2)	33.9±1.04	30.86±1.02	0.0001***
EAT-26 score	27.07±0.88	23.07±0.88	0.0001***

Data were expressed as mean and SD. (***P<0.001 is significant). EAT-26: Eating attitude test 26, BMI: Body mass index

Table 4: Comparison of body weight, BMI and EAT-26 score before and after 20 weeks of non-invasive electrical vestibular nerve stimulation in females

Parameter	Before (n=15)	After (n=15)	P-value
Weight (kg)	90.73±4.17	81.13±3.89	0.0001***
BMI (kg/m^2)	34.53±0.87	30.86±0.867	0.0001***
EAT-26 score	26.80±0.77	22.80±1.15	0.0001***

Data were expressed as mean and SD. (***P<0.001 is significant). EAT-26: Eating attitude test 26, BMI: Body mass index

DISCUSSION

The current study observed the effectiveness of 20 weeks of non-invasive electrical vestibular nerve stimulation in the management of obesity. The size and number of fat cells increase in the body in obesity. Obesity is associated with multiple non-communicable diseases, such as diabetes and cardiovascular diseases, which contribute for maximum mortality throughout the world.[11] Anti-obesity medications are available to manage obesity but are associated with side effects with long-term use. Research is ongoing in this area to understand the details of the side effects involved.[12] Modification of lifestyle that changes in the diet, such as using low-calorie diet and low-fat diet are showing better results in decreasing weight.[13] The vestibular system is one of the sensory systems that starts functioning right from the fetal life. Though it was thought that the vestibular system is mainly for the maintenance of balance and equilibrium, it also contributes for homeostasis. Hence, the vestibular system is called as sixth sense.[14] The Hypothalamus was reported to regulate the food intake and metabolic functions. Hence, any treatment modalities that can act through the hypothalamus are effective in the management of obesity.[15] Vestibular stimulation through non-invasive electrical stimulation was reported to influence the hypothalamus and maintain the set point for body fat.[16] Hot and cold caloric vestibular stimulation was reported to decrease the cholesterol in hyperlipidemia-induced Wistar albino rats.[7] Interestingly, it was reported that lesions to the vestibular system lead to impaired glucose metabolism and influence the obese state.[17] Further, it was reported that bone mass was regulated by the vestibular system.[17] The Vestibular system is connected with the brain structures, such as an arcuate nucleus, dorsal raphe nucleus, nucleus of tractus solitaries, and locus coerulues, and regulates food intake.[18] Vestibular stimulation also influences the food intake through hormonal regulation mainly thyroid hormone and insulin.[19] Vestibular stimulation influences the secretion of insulin through vagal stimulation.[6] In an earlier pilot study conducted by the authors, there was a significant decrease in body weight and BMI.[10] The present study confirms a decrease in the body weight and BMI followed by the long-term vestibular stimulation. The study also supports the safety of usage of vestibular stimulation for a long-term basis as there were no adverse effects reported by the participants.

Limitations of the study

The study does not have a sham stimulation group and the participants acted as self-controls.

CONCLUSION

The current study results support the implementation of non-invasive electrical vestibular nerve stimulation in combination with a lacto-vegetarian diet in the management of obesity. Further, the study presents that non-invasive electrical vestibular nerve stimulation is safe to use in a long-term basis.

ACKNOWLEDGMENT

Authors thank Dr. Jason McKeown, CEO, Neurovalens for providing the devices for non-invasive electrical vestibular nerve stimulation. Special thanks to all the participants.

REFERENCES

1. Apovian CM. Obesity: Definition, comorbidities, causes, and burden. Am J Manag Care. 2016;22(7 Suppl):S176-S185.
2. Lin X and Li H. Obesity: Epidemiology, pathophysiology, and therapeutics. Front Endocrinol (Lausanne). 2021;12:706978. https://doi.org/10.3389/fendo.2021.706978
3. Cross L. Management of obesity. Am J Health Syst Pharm.

2025;82(2):48-59.

https://doi.org/10.1093/ajhp/zxae273

4. McKeown J, McGeoch PD and Grieve DJ. The influence of vestibular stimulation on metabolism and body composition. Diabet Med. 2020;37(1):20-28.

   https://doi.org/10.1111/dme.14166

5. Kawao N, Takafuji Y, Ishida M, Okumoto K, Morita H, Muratani M, et al. Roles of the vestibular system in obesity and impaired glucose metabolism in high-fat diet-fed mice. PLoS One. 2020;15(2):e0228685.

   https://doi.org/10.1371/journal.pone.0228685

6. Sailesh KS, Archana R and Mukkadan JK. Vestibular stimulation: A simple but effective intervention in diabetes care. J Nat Sci Biol Med. 2015;6(2):321-323.

   https://doi.org/10.4103/0976-9668.159991

7. Sadanandan NN, Archana R, Sailesh KS, Mukkadan JK and Antony NJ. Antihyperlipidemic effect of vestibular stimulation in wistar albino rats. Int J Res Ayurveda Pharm. 2015;6(4):509-512.

   https://doi.org/10.7897/2277-4343.06496

8. Sailesh KS. Vestibular balance of food intake. Int J Pharm Bio Sci. 2014;5(3):1069-1073.

9. Garner DM, Olmsted MP, Bohr Y and Garfinkel PE. The eating attitudes test: Psychometric features and clinical correlates. Psychol Med. 1982;12(4):871-878.

   https://doi.org/10.1017/s0033291700049163

10. Goothy SS, Bhise S, Parapurath S, Choudhary A, Gawarikar S, Vijayaraghavan R, et al. Effectiveness of 12 weeks of electrical vestibular nerve stimulation in the management of obesity: A pilot study. Asian J Med Sci. 2022;13(11):300-304.

11. Venkatrao M, Nagarathna R, Majumdar V, Patil SS, Rathi S and Nagendra H. Prevalence of obesity in India and its neurological implications: A multifactor analysis of a nationwide cross-sectional study. Ann Neurosci. 2020;27(3-4):153-161.

    https://doi.org/10.1177/0972753120987465

12. Perdomo CM, Cohen RV, Sumithran P, Clément K and Frühbeck G. Contemporary medical, device, and surgical therapies for obesity in adults. Lancet. 2023;401(10382):1116-1130.

    https://doi.org/10.1016/S0140-6736(22)02403-5

13. Aldubikhi A. Obesity management in the Saudi population. Saudi Med J. 2023;44(8):725-731.

    https://doi.org/10.15537/smj.2023.44.8.20220724

14. Rossi S, Cinti A, Viberti F, Benelli A, Neri F, De Monte D, et al. Frequency-dependent tuning of the human vestibular “sixth sense” by transcranial oscillatory currents. Clin Neurophysiol. 2023;153:123-132.

    https://doi.org/10.1016/j.clinph.2023.06.013

15. McKeown J, McGeoch PD and Grieve DJ. The influence of vestibular stimulation on metabolism and body composition. Diabet Med. 2020;37(1):20-28.

    https://doi.org/10.1111/dme.14166

16. McGeoch PD. Can vestibular stimulation be used to treat obesity?: Vestibular stimulation targeting the otoliths could rebalance energy homeostasis to trigger a leaner body habitus and thus treat metabolic syndrome. Bioessays. 2019;41(2):e1800197.

    https://doi.org/10.1002/bies.201800197

17. Sailesh KS. Vestibular balance of food intake. Int J Pharm Bio Sci. 2014;5(3):1069-1073.

18. Kumar SS, Archana R, Antony NJ and Mukkadan JK. Controlled vestibular stimulation: Supplementary treatment for hypothyroidism. Res J Pharm Biol Chem Sci. 2014;5(3):1842-1845.

Authors' Contributions:
NK, VM- Design of the study, review of literature, analysis and preparing the manuscript; **DSV, NK**- Data collection, preparing the manuscript; **SSKG**- Analysis and preparing the manuscript.

Work attributed to:
Arunai Medical College and Hospital, Tamil Nadu, India & NRI Institute of Medical Sciences, Visakhapatnam, Andhra Pradesh, India.

Orcid ID:
Dr. Nithiya K - https://orcid.org/0009-0007-4485-9617
Dr. Vinothini M - https://orcid.org/0009-0006-9139-1626
Dr. Deepan Suresh V - https://orcid.org/0000-0002-9309-2551
Dr. Sai Sailesh Kumar Goothy - https://orcid.org/0000-0002-2578-6420

Source of Support: Nil, **Conflicts of Interest:** None declared.