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(RESEARCH ARTICLE)

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Comparative analysis of visual evoked potentials in obese and non-obese individuals: A cross-sectional study

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Abstract

Background: Obesity has been associated with alterations in central nervous system (CNS) function, including impaired sensory processing. Visual evoked potentials (VEPs), which reflect cortical processing of visual stimuli, may provide insight into obesity-related changes in the visual system. This study aimed to compare VEP characteristics between obese and non-obese individuals.

Methods: We conducted a cross-sectional study involving 40 obese individuals (body mass index (BMI >25) and 40 age and gender matched non-obese controls (BMI <25). VEPs were recorded using a standard visual stimulation protocol, and latency and amplitude of the P100 wave were analyzed.

Results: Obese individuals demonstrated significantly increased P100 latency (108.2 ± 7.3ms) compared to non-obese individuals (93.5± 6.8 ms, $p<0.01$). Furthermore, there were no significant difference in P100 amplitude between the two groups (obese 7.5 ± 1.5 µV; non-obese 8.0 ± 1.9 µV, $p > 0.05$).

Conclusion: Our findings suggest that obesity is associated with delayed cortical visual processing, as reflected by increased latency in VEPs. These changes may indicate underlying alterations in the visual pathways and warrant further investigation into the impact of obesity on CNS function.

Keywords: Obesity; Visual Evoked Potentials (VEP); P100 Latency; Cortical Processing; Cross-Sectional Study

1. Introduction

Obesity is a global epidemic linked to various metabolic and cardiovascular disorders, but its impact on brain function, particularly on visual processing, remains under-explored [1]. Visual evoked potentials (VEPs) are a well-established electrophysiological measure of cortical visual processing, reflecting the brain's response to visual stimuli. Changes in VEP characteristics, such as prolonged latency or diminished amplitude, can indicate alterations in the integrity of the visual pathways [2, 3].

Previous research has primarily focused on the impact of obesity on metabolic health, while its effect on neural function is still being elucidated. Studies have suggested that obesity may impair CNS functioning through mechanisms such as inflammation, oxidative stress, and insulin resistance [4, 5]. Though few studies have investigated whether obesity is associated with measurable changes in VEPs, this study is the first, to our knowledge, to analyse VEP changes in South Indian obese population (BMI >25). This study thus aims to compare the VEP parameters between obese and non-obese individuals, hypothesizing that obesity is associated with delayed VEP latency and reduced amplitude.

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2. Methodology

2.1. Study Participants

The sample size of 40 participants per group was calculated based on an estimated effect size derived from previous studies [1, 2]. 40 obese (BMI >25) and 40 non-obese (BMI <25) individuals were recruited for this cross-sectional study according to the South Asian classification of BMI. Study participants were recruited after obtaining written informed consent. Participants were matched for age, gender, and socioeconomic status. Exclusion criteria included significant neurological conditions, ocular diseases, or psychiatric disorders.

2.2. Instruments and Procedure

VEP recordings were conducted using a standard visual stimulation protocol. A black-and-white checkerboard pattern was presented on a monitor at a 15° visual angle. Stimuli were flashed at 1 Hz, and electrodes were placed according to the 10-20 International System: one electrode at Oz (occipital midline), and two additional electrodes at Fz and Cz (frontal and central midline) for reference and ground.

VEP responses were recorded using the instrument Physiopac-PP4, Medicaid System, Chandigarh with a sampling rate of 1000 Hz. Latency (P100) and amplitude (P100) were analyzed. The P100 wave is identified as the peak occurring around 100 ms following the stimulus.

2.3. Statistical Analysis

VEP data were analyzed using independent t-tests to compare latency and amplitude between obese and non-obese groups. A significance level of $p < 0.05$ was considered statistically significant.

3. Results

Table 1 Demographic details

Characteristic	Obese Group (n=40)	Non-Obese Group (n=40)	p-value
Age (years)	28.4 ± 4.5	29.1 ± 4.3	$p > 0.05$

Table 2 VEP Characteristics

Characteristic	Obese Group (n=40)	Non-Obese Group (n=40)	p-value
P100 Latency (ms)	108.2 ± 7.3	93.5 ± 6.8	$p < 0.01$
P100 Amplitude (μV)	7.5 ± 1.5	8.0 ± 1.9	$p > 0.05$

4. Discussion

This study demonstrates that obesity is associated with significant alterations in VEP characteristics, specifically delayed latency of the P100 wave. These findings suggest that obesity may impair cortical visual processing, potentially through mechanisms such as neuro-inflammation, oxidative stress, or metabolic dysregulation [6, 7].

The delayed latency observed in obese participants may indicate slowed conduction through the visual pathways, possibly due to obesity-induced changes in neuronal function or synaptic efficiency. Additionally, the lack of significant differences in amplitude suggests that obesity may not universally affect neuronal responsiveness to visual stimuli, as previously hypothesized [8, 9].

Previous research on the effects of obesity on brain function supports these findings. Obesity is known to increase levels of systemic inflammation, which can affect brain structure and function, including the visual pathways. Elevated pro-inflammatory markers such as TNF-α, IL-6, and CRP have been linked to impaired cortical processing [10]. Additionally, increased oxidative stress and insulin resistance, both prevalent in obesity, can contribute to neurophysiological

impairments [11]. Our results also align with previous studies that have shown altered VEPs in populations with neurological conditions such as diabetes and multiple sclerosis [12].

4.1. Limitations

The study did not assess potential confounding factors such as physical activity level, diet, or genetic predisposition, which could influence VEP results. Insulin resistance in obese individuals was not measured. Future studies should consider including these factors to provide a more comprehensive understanding of the relationship between obesity and VEP alterations.

5. Conclusion

In conclusion, this study provides evidence that obesity is associated with significant changes in VEP characteristics, including prolonged latency. These findings suggest that obesity may affect cortical visual processing, potentially through neuroinflammatory, oxidative, and metabolic pathways. Further research is needed to explore the underlying mechanisms and clinical implications of these changes, particularly their role in the early detection of obesity-related neurological dysfunction.

Compliance with ethical standards

Disclosure of conflict of interest

No conflicts of interest to disclose.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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