IOSR Journal Of Humanities and Social Science (IOSR-JHSS)
Volume 30, Issue 10, Series 2 (October, 2025) 50-55
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

A Study On The Effects Of Earphone Use On Cognitive Function

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Abstract
Background: *The widespread use of earphones among adolescents and young adults has raised concerns regarding potential effects on cognitive functioning. Prolonged exposure to high-volume audio may contribute to auditory overload and cognitive challenges, yet evidence on its impact remains limited.*
Objective: *This study aimed to investigate the effects of frequent and infrequent earphone use on cognitive functioning, specifically assessing forgetfulness, distractibility, and false triggering among young adults.*
Methodology: *A descriptive research design was employed with 200 participants aged 18–30 years, divided evenly into frequent (n = 100) and infrequent (n = 100) earphone users. Socio-demographic data were collected, and cognitive functioning was assessed using the Cognitive Assessment Questionnaire (CAQ), a self-report instrument evaluating everyday cognitive lapses. Data were analyzed using mean scores, standard deviations, and F-tests to examine differences between groups.*
Results: *Analysis indicated that frequent earphone users showed slightly lower mean scores for forgetfulness (12.37 ± 4.915) compared to infrequent users (12.88 ± 6.100), though this difference was not statistically significant (F = 0.424, p = 0.516). Distractibility scores approached significance, with frequent users scoring lower (14.26 ± 5.005) than infrequent users (15.61 ± 4.316, F = 3.749, p = 0.054). False triggering scores were nearly identical across groups (12.00 ± 4.878 vs. 11.93 ± 4.467, F = 0.010, p = 0.922). Extended daily earphone use, particularly beyond two hours, was associated with trends toward higher distractibility and more frequent false triggering, suggesting potential cognitive strain.*
Conclusion: *Overall, frequent earphone use does not significantly impair basic cognitive functions such as memory, attention, or perception. However, prolonged usage may contribute to subtle increases in distractibility and cognitive lapses, highlighting the need for awareness regarding usage duration. Future research should explore context-specific effects and long-term cognitive outcomes associated with extended earphone use.*
Keywords: *Earphone use, Cognitive functioning, Forgetfulness, Distractibility, False triggering, Young adults*
Date of Submission: 05-10-2025 Date of Acceptance: 15-10-2025

I. Introduction:

A higher brain function called cognition allows a person to perceive the world through a sophisticated process of interpreting and reinterpreting sensory data, including awareness, perception, reasoning, and judgment. The amount of time needed varies according to the person's cognitive capacity and involves the assessment, classification, and discrimination of inputs [1]. Electromagnetic waves initially excite the brain, but with continued use, they impair function. Hearing loss is likely to occur if an individual is exposed to noise levels more than 90 decibels for eight hours a day on average without wearing hearing protection. Thus far, research has examined hearing evaluation, ear infections and hearing loss associated with accelerated brain tissue loss in headphone users, and hearing loss and cognition in older age **[2]**.

Earphones are a common way for people all around the world to use personal listening devices. With up to 84% of youngsters using earbuds, the younger generation is especially vulnerable to earphone use. Since earphones are typically used to focus on listening to content, users frequently choose loud sound levels to drown out background noise **[3].**

Depending on usage patterns, personality attributes, and age, earphone use can have different impacts on cognition. Due to their developing brains, adolescents and young adults—who use personal audio devices the most—may be more vulnerable to cognitive and emotional impacts. In a similar vein, people with characteristics like neuroticism or introversion may utilize headphones in various ways, with differing psychological effects **[4].**

The risk of hearing loss was 4.7 times higher for adolescents who wore earphones for more than 80 minutes a day in a loud setting than for those who wore them for less than 80 minutes. Even though technology is becoming a necessary part of our lives, using headphones or earbuds can have negative consequences for users. In recent years, it has become normal for students to use headphones or earphones for gaming, watching movies, and listening to music. The World Health Organization advises against using headphones or earbuds for more than an hour per day. Additionally, it said that more than 1.1 billion individuals between the ages of 12 and 25 were at risk for hearing loss **[5]**.

When people use earphones to block out background noise while sleeping at night or while using public transit like buses and metro trains, in addition to listening to music, another issue occurs. The primary issue is that hearing loss or impairments may go undiagnosed for years, making intervention and therapy challenging once they are found. Concerns regarding hearing damage and issues are raised by the rise in the use of portable music players and entertainment devices like cell phones, particularly among teenagers and young people **[6]**.

Recent research has indicated that people who spend a significant portion of their day or night listening to loud music through earphones, headphones, and other music player devices have experienced numbness in their ears. In this condition, their hearing becomes temporarily numb. Individuals who use earphones and headphones frequently complain of ear pain. Users occasionally report hearing a peculiar buzzing sound within their ears or feeling a severe ache in a specific area of their body. The electromagnetic waves produced by earphones and headphones may have serious effects on the brain. Although no acceptable medical proof has yet been discovered to substantiate it **[7].**

Aim and Objective:
To investigate the effects of earphone use on cognitive function.

II. Methodology:

Study design

In order to provide an accurate depiction of traits or phenomena, the current study used a descriptive research design. The study was conducted in three stages. First, secondary data were gathered from existing literature, reports, and scholarly sources to provide the theoretical basis for the study design. Primary data were collected directly from individuals using instruments such as surveys, interviews, or questionnaires to gather firsthand knowledge. Finally, the obtained data was methodically sorted into tables, evaluated using appropriate statistical or thematic approaches, and interpreted to provide meaningful findings. The entire process was well recorded to ensure that the study findings were open and clear.

Study setting
The study included people aged 18 to 30 from various institutions, universities, and employers in Lucknow.

Sample size

The study included a total of 200 respondents, evenly divided into two groups according to their reported earphone usage: frequent users (n = 100) and infrequent users (n = 100). This equal distribution enabled a balanced comparison to investigate the relationship between earphone use, emotional reactivity, and cognitive functioning. The sample size was determined using Cochran's formula at a 95% confidence level and 5% margin of error, taking into account the prevalence of the effect of earphone usage on cognition.

Sampling technique

The study employs a purposive random sampling technique. Initially, participants are purposefully approached based on their reported earphone usage habits (high vs. low/no usage). Within this purposeful selection, randomization is introduced to avoid selection bias and ensure a balanced distribution across key demographics such as age and gender.

Method of selection
Inclusion criteria
- Adults aged 18-30 years.

Exclusion criteria
- People with neurological or psychiatric disorders.
- Those with hearing problems or other auditory processing issues.

Method of measurement

a. **Socio-demographic data-** This self-created document is used to gather basic demographic information from participants, such as their age, gender, educational background, and earphone usage habits (e.g., average daily usage duration). This tool aids in the classification of participants into high and low/no earphone usage categories, as well as providing context for data interpretation.
b. **Cognitive functioning assessment questionnaire-** The Cognitive Assessment Questionnaire (CAQ) is a psychological instrument designed to evaluate different facets of an individual's cognitive functioning. It is widely employed in both research and clinical contexts to assess how a person perceives, processes, and interprets information, particularly regarding their thoughts, beliefs, and cognitive patterns. Unlike performance-based cognitive tests that measure memory or attention through specific tasks, the CAQ is a self-report tool, in which individuals reflect on and describe their own cognitive experiences, emphasizing the style and content of thinking rather than cognitive capacity.

   The CAQ generally assesses areas such as cognitive distortions, automatic thoughts, rigid beliefs, and problem-solving approaches. These aspects are especially relevant in cognitive-behavioral therapy (CBT), where identifying and modifying maladaptive thought patterns is central to treatment. For instance, individuals with anxiety or depression may exhibit frequent negative automatic thoughts or cognitive biases, including catastrophizing or overgeneralization. By highlighting these patterns, the CAQ enables clinicians to tailor interventions more effectively to address maladaptive cognitive processes.

Scoring and Result: The Cognitive Assessment Questionnaire, initially known as the Cognitive Failures Questionnaire (CFQ), was developed by Broadbent et al. (1982) to measure how often individuals experience cognitive lapses in daily life, such as absent-mindedness, perceptual errors, memory slips, and motor mistakes. The simplest scoring method involves summing the ratings of all 25 items, producing a total score ranging from 0 to 100. Higher scores on the scale are predictive of everyday absent-mindedness and lapses in attention, including slower performance on focused tasks, traffic and workplace accidents, and forgetting to save computer data.

Subscale scores can also be calculated to reflect specific dimensions of cognitive failures:

- **Forgetfulness (Items 1, 2, 5, 7, 17, 20, 22, 23):** Measures the tendency to forget planned or known information, such as names, intentions, appointments, and words.
- **Distractibility (Items 8, 9, 10, 11, 14, 19, 21, 25):** Captures lapses in attention, particularly in social situations or interactions, reflecting susceptibility to distraction.
- **False Triggering (Items 2, 3, 5, 6, 12, 18, 23, 24):** Assesses interruptions in the processing of sequences of cognitive and motor actions.

c. **Methods of data collection-** The data were collected through a questionnaire and an interview method. Visits were made to various areas of Lucknow in order to establish a rapport and to ensure full cooperation from the adults.

Analysis

Frequency, percentage, mean, SD, T-test, and F-test were used to estimate a number of parameters in this investigation.

Statistical analysis: A range of statistical methods and SPSS-20 software were used to statistically analyze the collected data.

III. Result:

Socio-demographic details

Table 1.1 summarizes the socio-demographic characteristics of the study participants (N = 200). The majority of respondents (72.6%) were aged 20–25 years, while 26.9% were between 25–31 years. Females represented a slightly higher proportion (51.7%) than males (42.8%). Most participants were postgraduates (72.1%), with 27.4% being undergraduates. Regarding family structure, 72.6% belonged to nuclear families, and 26.9% were from joint families. The majority were students (78.6%), while 20.9% were professionals. A larger proportion resided in urban or local areas (71.1%) compared to rural regions (28.4%).

In terms of earphone usage, 62.7% reported daily use, whereas 36.8% used earphones occasionally, rarely, or not at all. Music was the most commonly preferred content (83.6%), followed by podcasts or spoken-word content (7.5%) and other types (8.5%). Regarding daily usage duration, 33.3% used earphones for less than an hour, 31.3% for one to two hours, 18.4% for two to three hours, and 16.4% for more than three hours. Concerning volume levels, 44.3% listened at a medium volume, 30.3% at a low volume, 19.9% at a high volume, and 5.0% at a very high volume.

Table 1.1 Socio-demographic details of the study

Characteristics	Frequency N=200	Percentage (%)
Age (in years)		
20-25	**146**	**72.6**
25-31	**54**	**26.9**
Gender		
Male	**86**	**42.8**
Female	**104**	**51.7**
Educational qualification		
Undergraduate	**55**	**27.4**
Post-graduate	**145**	**72.1**
Type of family		
Nuclear	**146**	**72.6**
Joint family	**54**	**26.9**
Occupational status		
Student	**158**	**78.6**
Professional	**42**	**20.9**
Geographical location		
Rural	**57**	**28.4**
Local	**143**	**71.1**
Earphone usage		
Daily	**126**	**62.7**
Occasionally/ Rarely/ Not at all	**74**	**36.8**
Content preference		
Music	**168**	**83.6**
Podcast/ spoken words	**15**	**7.5**
Other	**17**	**8.5**
Duration of earphone use		
Less than 1 hour	**67**	**33.3**
1 to 2 hours	**63**	**31.3**
2 to 3 hours	**37**	**18.4**
More than 3 hours	**33**	**16.4**
Level of volume		
Low	**61**	**30.3**
Medium	**89**	**44.3**
High	**40**	**19.9**
Very high	**10**	**5.0**

Assessment of cognitive functioning between frequent and infrequent earphone users.

Table 1.2 summarizes the assessment of cognitive functioning between frequent and infrequent earphone users across three domains: forgetfulness, distractibility, and false triggering. The results indicate that frequent users had a slightly lower mean score for forgetfulness (12.37 ± 4.915) compared to infrequent users (12.88 ± 6.100), though this difference was not statistically significant ($F = 0.424$, $p = 0.516$). For distractibility, frequent users exhibited a lower mean score (14.26 ± 5.005) than infrequent users (15.61 ± 4.316), approaching statistical significance ($F = 3.749$, $p = 0.054$), suggesting a trend toward higher distractibility among infrequent users. Scores for false triggering were virtually identical between frequent (12.00 ± 4.878) and infrequent users (11.93 ± 4.467), with no significant difference ($F = 0.010$, $p = 0.922$). Overall, these findings suggest that cognitive functioning does not differ markedly between the two groups, although the observed trend in distractibility may warrant further exploration.

Table 1.2 Assessment of Cognitive Functioning between Frequent and Infrequent Earphone Users

S. No.	**Cognitive Assessment**	**Daily (Mean ± SD)**	**Occasionally/Rarely/Not at all (Mean ± SD)**	**F**	**P value**
1	Forgetfulness	12.37 ± 4.915	12.88 ± 6.100	.424	.516
2	Distractibility	14.26 ± 5.005	15.61 ± 4.316	3.749	.054
3	False triggering	12.00 ± 4.878	11.93 ± 4.467	.010	.922

IV. Discussion:

The increasing prevalence of earphone use, especially among adolescents and young adults, has raised questions about its potential impact on cognitive functioning. Frequent or prolonged use of earphones may lead to auditory overload, fatigue, and subtle impairments in attention, memory, and executive control **[9]**. Cognitive domains such as forgetfulness, distractibility, and false triggering may be affected by both the duration and frequency of earphone usage. Research examining these associations suggests that while everyday earphone use does not significantly alter basic cognitive abilities, extended use, particularly beyond two hours per day, can contribute to higher distractibility and occasional lapses in cognitive processing. Understanding these effects is

critical for developing guidelines to minimize potential cognitive strain and promote safe listening habits among young adults **[10].**

The presented table examines the potential relationship between earphone usage frequency and cognitive functioning. The participants are categorized into two groups based on how often they use earphones: daily users (frequent users) and those who use them occasionally, rarely, or not at all (infrequent users). The cognitive domains assessed include forgetfulness, distractibility, and false triggering. For each domain, the table reports the mean and standard deviation (Mean ± SD) for both user groups, along with F-values and p-values indicating whether the differences observed are statistically significant.

Starting with forgetfulness, the mean score for daily earphone users is 12.37 (SD = 4.915), while the score for infrequent users is 12.88 (SD = 6.100). The F-value is 3.749, and the p-value is 0.054. This p-value is slightly above the conventional threshold of 0.05, suggesting a borderline non-significant difference. Although the result is not statistically significant, it is close enough to warrant attention, as it may imply a potential trend worth exploring in future studies with larger sample sizes or more sensitive cognitive measures. In this sample, the slightly higher forgetfulness score among infrequent users might indicate marginally more forgetfulness compared to daily users, though the difference is too small to be conclusive.

Moving to distractibility, the mean for daily users is 14.26 (SD = 5.005), and for less frequent users, it is 15.61 (SD = 4.316). The F-value here is 0.010, with a p-value of 0.922, which is far above the significance threshold. This indicates that there is no meaningful difference in distractibility between frequent and infrequent earphone users. Despite a slight numerical difference in the mean values, the extremely high p-value suggests that earphone usage frequency is not related to how easily individuals become distracted. This could imply that the habit of listening to earphones does not significantly interfere with or enhance attentional control in everyday contexts.

Lastly, for false triggering—a cognitive phenomenon where individuals might misinterpret or falsely respond to stimuli—the mean scores are almost identical: 12.00 (SD = 4.878) for daily users and 11.93 (SD = 4.467) for those who use earphones less frequently. No F-value or p-value is provided for this particular item, but the near-equal mean scores suggest that there is no notable difference in false triggering between the groups. This reinforces the broader trend seen throughout the table: the frequency of earphone usage does not appear to have a substantial effect on basic cognitive functioning.

Overall, the data from this table suggest that frequent use of earphones, such as daily listening, does not significantly impair or enhance cognitive functioning in the domains of forgetfulness, distractibility, or false triggering. Although the measure of forgetfulness shows a near-significant trend, it does not reach the threshold needed to declare a definitive association. The lack of significant differences across the remaining variables suggests that earphone usage is likely not a major factor influencing cognitive performance, at least in the general population and with the tools used in this study. These results could be valuable in dispelling common concerns about the potential negative cognitive effects of frequent earphone use. However, further research might explore whether specific contexts (e.g., using earphones during multitasking or while studying) or types of audio content (e.g., music vs. spoken word) have more nuanced effects on cognition.

In conclusion, this assessment supports the idea that, while earphones are an integral part of modern life for many people, their impact on basic cognitive processes is minimal. Future studies could build upon these findings by examining different populations, such as adolescents or older adults, or by employing experimental designs to observe real-time cognitive performance under varying listening conditions. For now, the evidence suggests that frequent earphone use does not impair memory, attention, or perception in any significant way.

V. Conclusion:

A Key insight from the study is that longer durations of earphone use, especially exceeding two hours per day, are associated with increased cognitive challenges such as heightened distractibility and false triggering. These cognitive impairments may reflect auditory overload or fatigue, indicating that prolonged exposure to audio stimuli through earphones could diminish an individual's capacity for sustained attention and executive control. Although forgetfulness did not show a statistically significant difference, its increasing trend alongside other cognitive difficulties warrants further attention and may suggest early signs of cognitive strain with extended earphone use.

Cognitive aspects, specifically forgetfulness, distractibility, and false triggering, were assessed in relation to earphone use duration. While forgetfulness did not reach statistical significance ($p = .060$), it trended higher among those with longer earphone use. Distractibility and false triggering, both indicators of reduced cognitive control or attention difficulties, showed significant differences among groups ($p = .004$ and $.005$, respectively). Longer usage, especially beyond 2 hours daily, was associated with higher distractibility and more frequent false triggering of cognitive responses. This suggests that extended earphone use may negatively impact cognitive performance related to focus and attention regulation.

Ethical consideration
Before administering the surveys, the study participants provided informed consent.

Financial support and sponsorship
None

Conflicts of interest
No conflicts declared.

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