

Title of Proposal

Evaluation of over-the-counter earbuds to improve hearing and communication

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Structured Abstract

OBJECTIVES.

Barriers to hearing aid use include the cost of devices and inconvenience and cost of visiting a hearing professional. Recently, more affordable earbud-style devices with features designed to help people hear better (e.g. Apple AirPods Pro, Nuheara IQbuds PRO) have become available and may be easily purchased by consumers. The objective of this research was to evaluate the effectiveness of an over-the-counter earbud with smart hearing features using a multi-faceted approach, and determine how it can help improve hearing and communication for people with hearing loss or hearing difficulties.

DESIGN.

Objective, behavioural and subjective testing methods were applied. Objective measurements were conducted in an acoustic test room with a horizontal circular array of 16 loudspeakers to simulate a target talker and noisy environment. Performance measures of the device characterised the gain and compression provided for a particular hearing profile, and the amount of signal-to-noise ratio advantage achieved by activating directionality and noise reduction features. Speech-in-noise sentence testing was performed within the same laboratory arrangement. 17 adults (21—59 years) with self-reported speech-in-noise hearing difficulties and a Revised Hearing Handicap Inventory and Screening questionnaire score greater than 7 were recruited. Participants completed the test both unaided and with the earbuds customised using their pure-tone audiogram. To complement laboratory measures, real-world experiences were captured using a smartphone-based ecological momentary assessment (EMA) app over a four-week period. The EMA app recorded participants' listening experiences in their daily life with and without the earbuds while also measuring acoustic features of the environment.

RESULTS.

Acoustic measures showed that the gain provided by the earbuds generally overamplified loud sounds and underamplified soft sounds compared to NAL-NL2 hearing aid prescription. The directionality feature provided an improvement in speech intelligibility index (SII)-weighted SNR of around 5 dB. Speech-in-noise testing showed that intelligibility increased from 54.6% to 66.4% on average when participants wore the earbuds, and participants rated that their listening effort and mental demand reduced. EMA data revealed that participants found their overall hearing experience and speech understanding slightly better in their daily life, however, the benefit was mostly limited to certain situations. Some participants reported comfort issues and stigma associated with earbuds not being perceived as assistive listening devices.

CONCLUSIONS.

The data demonstrate that while differences to traditional hearing aids exist, over-the-counter earbud-style hearing devices can enable people with hearing loss or hearing difficulties to hear quiet sounds more easily, improve speech understanding and increase listening comfort during conversations in noisy situations. The real-world data provides rich insight to complement the laboratory measures and highlights a range of user considerations that influence whether these devices are suitable and desirable for an individual.