

# Noise Exposure and Hearing Health: A Study of Baristas' Perception, Knowledge, and Attitudes in Malaysian Speciality Coffee Shops

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## ABSTRACT

**Background:** Noise-induced hearing loss (NIHL) is a significant occupational health issue globally, with service industry workers, including baristas, often overlooked despite their exposure to potentially hazardous noise levels. This study aimed to measure noise levels in speciality coffee shops within the Kuantan municipality area and evaluate baristas' knowledge, attitudes, and perceptions of noise and its impacts. **Method:** Noise levels were assessed using the NIOSH Sound Level Meter App during typical workdays, while 30 baristas completed questionnaires structured around the Health Belief Model (HBM). **Results:** Noise levels measured in the cafés were within permissible limits. Baristas predominantly perceived noise as enhancing workplace ambience, with limited awareness of its adverse effects. Notably, none of the baristas reported ever using hearing protection devices (HPDs), highlighting a critical gap in preventive practices. Gender differences were observed in perceived susceptibility to hearing loss, with females reporting significantly higher scores than males ( $p = 0.02$ ). However, no significant gender differences were found in other health belief domains. **Conclusion:** These results highlight the need for targeted educational interventions to raise awareness of noise hazards and promote safer work practices among baristas. The study contributes to the broader understanding of occupational health in non-industrial sectors, highlighting the importance of addressing noise exposure in the growing speciality coffee industry.

## Keywords:

Barista; speciality coffee shop; noise levels; noise induced hearing loss; knowledge

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## INTRODUCTION

Noise-induced hearing loss (NIHL) is a leading occupational health concern globally, affecting over 500 million people worldwide, with at least 25% of workers exposed to hazardous noise levels (Phillips et al., 2019; World Health Organisation [WHO], 2021; Jo & Baek, 2024). NIHL remains a significant occupational health issue in Malaysia. In 2023, of the 11,747 occupational disease cases reported to the Department of Occupational Safety and Health (DOSH), 57.5% involved noise-induced hearing disorders, including NIHL and permanent hearing impairment, significantly exceeding the prevalence of musculoskeletal disorders (5.9%) and skin diseases (0.4%) (Department of Statistics Malaysia [DOSM], 2023; DOSH, 2024).

Extensive research has been conducted to evaluate the risks of NIHL among workers in industries such as manufacturing, construction, mining, and transportation, where prolonged exposure to machinery noise is a well-documented hazard (Chadha et al., 2021). However, service industries like hospitality have received comparatively less attention despite evidence showing that employees, including baristas and chefs, frequently encounter noise levels exceeding permissible exposure

limits (Green & Anthony, 2015; Al-Arja & Awadallah, 2020; Li et al., 2022; Mekonnen et al., 2022). This issue is particularly pertinent in Malaysia, where the speciality coffee industry has experienced substantial growth over the past decade, leading to a significant increase in the number of baristas potentially exposed to harmful noise (Lee et al., 2018; Ong, 2021; Foo, 2023).

Cafés are characterised by elevated noise levels, typically ranging from 66.5 to 81.9 dBA during operating hours and often surpassing Occupational Safety and Health (OSHA's) 90-dBA limit during peak periods (Al-Arja & Awadallah, 2020; Zelem et al., 2023). These high noise levels arise from various sources, including coffee-making equipment, the hum of espresso machines, grinding, steaming, customer conversations, background music, clinking dinnerware, and kitchen appliances (Kelly et al., 2012; Pienkowski, 2021). Modern interior design trends, such as industrial-style layouts, open kitchens, and the use of reflective materials like concrete, steel, and wood, further exacerbate the problem by creating reverberant spaces (Rusnock & Bush, 2012; Eichwald et al., 2022). Baristas, in particular, are at high risk due to their prolonged exposure to these noises.

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Other than hearing loss, the impact of elevated noise levels could lead to stress, reduced job satisfaction, and impaired social interactions, which could negatively affect workers' attitudes, behaviours, and overall well-being (Lao et al., 2013; Pursley & Saunders, 2016; Abbasi et al., 2024). However, workers in service industries often normalise elevated noise levels, underestimating the associated risks and adopting fewer protective measures (Goines & Hagler, 2022). Conversely, those with greater awareness of noise hazards and proactive attitudes are more likely to use hearing protection devices (HPDs) to safeguard their hearing (Ismail, 2013; Vosoughi et al., 2022; Guo et al., 2024).

Despite the rapid growth of Malaysia's speciality coffee industry, research on café environmental noise and baristas' perceptions, knowledge, and attitudes toward noise exposure remains limited. This study aims to measure noise levels in speciality coffee shops in Kuantan and evaluate baristas' knowledge, attitudes, and perceptions regarding noise and its impact. The findings are intended to raise awareness of occupational noise hazards and suggest educational strategies to promote a safer work environment.

## METHODOLOGY

This study employed a cross-sectional design, conducted in two parts: (1) measuring noise levels in cafés and (2) administering a set of questionnaires to assess baristas' perception, knowledge, and attitudes toward noise.

### Study Design and Sampling

Participants were recruited via convenience sampling based on the following inclusion criteria: current baristas in Kuantan, aged 18 or older, and capable of completing the questionnaire. Exclusion criteria excluded non-baristas, individuals under 18 years old, those with language or literacy barriers, and non-residents of Kuantan municipality, Pahang, Malaysia. A total of 30 cafés were approached, with 16 agreeing to participate, including two international chains, anonymised as Cafés 1–16. Power calculations ensured an adequate sample size.

### Noise Measurement Tool

Noise levels were measured using the National Institute for Occupational Safety and Health (NIOSH) Sound Level Meter (SLM) smartphone application installed on iPhones. This application was chosen for its reliability, accessibility, and comprehensive features designed specifically for occupational noise assessment (Murphy & King, 2016; Lee & Hampton, 2024). The app's availability on iOS platforms

makes it a practical alternative to conventional SLMs, which are more expensive.

The app provides real-time readings of key metrics, including A-weighted equivalent sound level (LAeq), C-weighted peak sound pressure level (LCpeak), time-weighted average (TWA), and noise exposure dose. It supports adjustable weighting (A, C, or Z) and allows data saving and sharing. With an accuracy of  $\pm 2$  dBA and global positioning system (GPS) functionality for geospatial mapping, the app is effective for occupational noise studies (Kardous & Shaw, 2014; Celestina et al., 2018; Jacobs et al., 2020).

### Noise Measurement Procedure

Noise levels in the cafés were measured over 15-minute periods, following NIOSH SLM App recommendations and local noise measurement guidelines (*Industry Code of Practice for Management of Occupational Noise Exposure and Hearing Conservation*, [ICOP], 2019). Measurements were taken in baristas' main workspaces during peak lunch hours (11:00 AM–2:00 PM) to represent typical noise exposure.

Using a smartphone with the NIOSH SLM App, microphones were angled at  $45^\circ$  to minimise interference, with devices either handheld or placed on a soft surface. Handheld measurements maintained a 1 m distance from noise sources at a height of 1 m. The app recorded one-second time-history data, including short-term and average LAeq, maximum and minimum noise levels, and standard deviations.

Each café was visited twice, with initial 10-minute noise samples screened for consistency. Spatial and operational factors were noted to contextualise the noise data, with average LAeq values serving as the primary metric for analysis.

### Questionnaire Administration

The study utilised a questionnaire adapted from validated tools (Saunders et al., 2014; Pursley & Saunders, 2016) with the authors' permission. It comprised three sections: demographics and HPD use (Section A); noise perception impacts (Section B), with 5 positive and 8 negative items on a 5-point Likert scale; and knowledge (16 items) and attitudes (22 items) on hearing loss prevention (Section C), structured using six Health Belief Model (HBM) domains. Expert face validation ensured clarity and strong internal consistency was confirmed (Cronbach's  $\alpha$ : perception 0.88, knowledge 0.93, attitudes 0.76).

Participants were briefed on the study objectives and consent was obtained before being given a QR Code to access the Google Form questionnaire to complete. Clarifications were encouraged to ensure accurate responses. Data was analysed using SPSS (Version 20).

## RESULTS

### Demographic data

A total of 30 participants, evenly split by gender (50% male, 50% female), aged 18–35 years (mean age  $24.63 \pm 3.91$ ), participated in the study. Half were aged 24–29 years, followed by 18–23 years (36.7%) and 30–35 years (13.3%). Most participants (70%) had worked as café workers for about a year. None of the participants reported using hearing protection devices while working or when exposed to loud noise.

### Noise Level Measured in the Cafés

The average noise levels recorded at 16 cafés in Kuantan are shown in Table 1.

**Table 1:** The average noise level measured at 16 cafés in Kuantan

Café	Average Recorded Noise Level (dBA)
1	72.5
2	68.9
3	69.2
4	68.2
5	76.6
6	76.9
7	74.4
8	81.4
9	69.9
10	73.2
11	73.6
12	67.7
13	76.0
14	75.2
15	70.3
16	73.1
Mean	72.94

Table 1 presents the average noise levels recorded at 16 cafés in Kuantan, with values ranging from 67.7 to 81.4 dBA. The mean noise level across all 16 cafés was 72.94 dBA, with 50% of cafés recording noise levels between 68.0 dBA and 76.0 dBA, reflecting moderate to high sound levels typical of café environments. Café 12 recorded the lowest noise level at 67.7 dBA, which falls within a range considered less likely to pose significant auditory risks. In contrast, Café 8 recorded the highest noise level at 81.4 dBA, approaching levels linked to elevated occupational

noise exposure, likely due to its open design and location on a busy city-centre road, both contributing to increased ambient noise. However, all recorded noise levels remained below the exposure limits set by the Malaysian noise regulations (DOSH, 2019).

### Perceptions of the Positive and Negative Impacts of Café Sounds

Tables 2 and 3 summarise baristas' perceptions of both the positive and negative impacts of café sounds.

**Table 2:** Perceptions of the Positive Impacts of Café Sounds (N = 30)

The sounds in the café...	Strongly Agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)
make for a fun workplace	11 (36.7%)	12 (40.0%)	6 (20.0%)	1 (3.3%)	0 (0%)
create a good atmosphere for customers	10 (33.3%)	11 (36.7%)	6 (20.0%)	2 (6.7%)	1 (3.3%)
make for an exciting place to be	14 (46.7%)	5 (16.7%)	8 (26.7%)	2 (6.7%)	1 (3.3%)
help customers relax	10 (33.3%)	5 (16.7%)	10 (33.3%)	3 (10.0%)	2 (6.7%)
help me focus on my work	10 (33.3%)	6 (20.0%)	10 (33.3%)	4 (13.3%)	0 (0%)

Table 2 shows that baristas largely perceived café sounds as enhancing both the workplace environment and customer experience. A substantial majority, 76.7% of baristas (36.7% strongly agree; 40.0% agree), felt that café sounds contributed to a fun workplace. Similarly, 70% (33.3% strongly agree; 36.7% agree) believed that these sounds fostered a positive atmosphere for customers. Subsequently, 63.4% (46.7% strongly agree; 16.7% agree) found these sounds exciting, highlighting their role in creating an engaging and lively environment.

However, the perceived benefit of café sounds for relaxation and focus were less conclusive. While half of the respondents (50%) agreed that café sounds helped customers relax, the remaining half were neutral or disagreed. Similarly, 53.3% reported that these sounds helped their concentration, but 46.7% expressed neutral or opposing views. This suggests that the positive impacts of café sounds may depend on individual preferences and situational factors.

**Table 3:** Perceptions of the Negative Impacts of Café Sounds (N = 30)

The sounds in the café...	Strongly Agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)
make it difficult to concentrate	1 (3.3%)	6 (20.0%)	9 (30.0%)	5 (16.7%)	9 (30.0%)
make me feel stressed	3 (10.0%)	0 (0%)	9 (30.0%)	4 (13.3%)	14 (46.7%)
might affect my hearing	3 (10.0%)	2 (6.7%)	10 (33.3%)	5 (16.7%)	10 (33.3%)
affect my ability to do my work	2 (6.7%)	4 (13.3%)	6 (20.0%)	6 (20.0%)	12 (40.0%)
make it difficult to hear co-workers	2 (6.7%)	7 (23.3%)	7 (23.3%)	6 (20.0%)	8 (26.7%)
make it difficult to hear customers	2 (6.7%)	5 (16.7%)	12 (40.0%)	6 (20.0%)	5 (16.7%)
cafe make it difficult to hear alerts/warnings/signals	2 (6.7%)	2 (6.7%)	11 (36.7%)	9 (30.0%)	6 (20.0%)
might affect customers' hearing	3 (10.0%)	3 (10.0%)	10 (33.3%)	7 (23.3%)	7 (23.3%)

The perceived negative impacts of café sounds were less pronounced but still notable, as shown in Table 3. Only 23.3% (3.3% strongly agree; 20% agree) of respondents agreed that café sounds made it difficult to concentrate, whereas nearly half (46.7%) either disagreed or strongly disagreed. Stress-related concerns were minimal, with 60.0% dismissing the notion that café sounds caused stress. Communication challenges emerged as a potential issue: Hearing Coworkers: 30.0% found it difficult to hear colleagues, while 46.7% disagreed; Hearing Customers: 23.4% noted difficulty in hearing customers, with 36.7% reporting no such issues; Hearing Alerts/Warnings: Only 13.4% struggled with auditory alerts, while 50.0% disagreed. Concerns about hearing impacts were also relatively low, with 16.7% agreeing that café sounds might affect hearing but 50.0% dismissing such risks.

### Baristas' knowledge towards noise based on gender

A Independent-Samples t-test was conducted to compare knowledge scores between male and female café workers. Before performing the t-test, Q-Q plots were examined to assess the normality assumption, revealing that

knowledge scores were approximately normally distributed for both groups. Additionally, Levene's test indicated that the variances were equal across the two groups. The t-test revealed no statistically significant difference in knowledge scores between genders,  $t(28) = 0.155, p = 0.878$ . Overall, most respondents, regardless of gender, scored less than 50%, indicating limited knowledge regarding noise and hearing, with only 5 out of 30 respondents scoring higher than 50%.

The analysis revealed no statistically significant difference in knowledge scores between male and female baristas. Most respondents, regardless of gender, scored below 50%, indicating a general lack of knowledge about noise and hearing. Only 5 of 30 respondents scored above 50%. Female baristas revealed slightly higher mean knowledge score ( $M = 5.60, SD = 3.38$ ) compared to males ( $M = 5.40, SD = 3.68$ ), with a mean difference of 0.20 (95% CI: -2.44 to 2.84). However, this difference was not statistically significant,  $t(28) = 0.15, p = 0.87$ , indicating that gender does not appear to influence knowledge levels in this sample.

Attitudes toward hearing loss prevention were analysed across six domains of the HBM: susceptibility, severity, barriers, benefits, self-efficacy, and cues to action. A Shapiro-Wilk test was conducted to assess the normality of each domain's distribution. Three domains (susceptibility, barriers, and self-efficacy) were normally distributed and analysed using independent-sample t-tests. The other three domains (severity, benefits, and cues to action) violated the normality assumption and were analysed using the Mann-Whitney U test. A significant gender difference was found in perceived susceptibility to hearing loss, with female baristas reporting a higher mean score ( $M = 15.00, SD = 11.50$ ) compared to males ( $M = 4.33, SD = 12.37$ ), yielding a mean difference of 10.67 (95% CI: 1.73, 19.60). The difference was statistically significant ( $t(28) = 2.45, p = 0.02$ ), suggesting that females perceive themselves as more vulnerable to hearing loss compared to males.

For other HBM domains, no statistically significant differences were observed. Perceived severity had mean ranks of 17.03 for females and 13.97 for males ( $Z = -0.98, p = 0.33$ ); perceived benefits (females: mean rank = 16.37, males: mean rank = 14.63,  $Z = -0.54, p = 0.59$ ), perceived barriers (mean difference = 6.11,  $t(28) = 0.74, p = 0.46$ ), perceived self-efficacy (mean difference = 7.08,  $t(28) = 0.82, p = 0.42$ ), and perceived cues to action (females: mean rank = 17.90, males: mean rank = 13.10,  $Z = -1.52, p = 0.13$ ) were similar across genders.

## DISCUSSIONS

This study highlights a multifaceted relationship between café noise levels, workers' perceptions, and health risks. While noise levels (67.7–81.4 dBA) across 16 cafés fell below hazardous thresholds set by Malaysian standards, prolonged exposure to peak levels, such as 81.4 dBA at Café 8 or occasional spikes above 90 dB from equipment, may pose auditory risks for baristas and other staff. These findings align with previous research in similar hospitality environments which found that even intermittent or peak noise exposures can contribute to NIHL (To & Chung, 2014; Green & Anthony, 2015; Pursley & Saunders, 2016; Li et al., 2022; Mekonnen et al., 2022). Such exposures, even if brief, may have cumulative effects over time, particularly in settings where staff work long shifts without hearing protection. Thus, these findings highlight the importance of implementing preventive measures and promoting hearing health education, even in workplaces that are not traditionally considered high-risk for occupational noise exposure.

Café noise variability highlights the potential for auditory discomfort during peak periods, exacerbated by prolonged exposure and cumulative lifestyle risks, such as attending music events without HPDs (Kelly et al., 2012; Alzahrani et al., 2018; Mina et al., 2023). Addressing these occupational and lifestyle exposures is critical for long-term hearing health.

The current study suggests that the NIOSH SLM apps can be utilised as one of the alternative screening tools in some settings. Similar findings were reported by previous studies, particularly when noise levels are stable and exceed 75 dBA (Kardous & Shaw, 2014; Celestina et al., 2018; Jacobs et al., 2020; Lee & Hampton, 2024).

Baristas perceived café sounds as positive for ambience and workplace enjoyment but reported challenges with communication and situational awareness. Despite these perceptions, all participants lacked awareness of noise-related health risks, and none reported using HPDs. Limited training in noise hazards, typical in the service sector, likely contributes to this gap, echoing findings from previous studies (Keppler et al., 2015). Educational interventions tailored to baristas could enhance noise risk awareness and encourage protective behaviours, reducing the risk of NIHL. Previous research has shown that ongoing hearing education programs effectively improve knowledge and preventive practices (Ismail, 2013; Saunders et al., 2014; McCullagh et al., 2020; Supramanian et al., 2023; Bramati et al., 2024).

Female baristas in this study reported a higher perceived

susceptibility to hearing risks compared to males, consistent with previous research suggesting women are more likely to engage in health-promoting behaviours (Liu et al., 2017; Luquis & Kensinger, 2018). In contrast, men are inclined to adopt unhealthy attitudes and are less likely to perceive themselves as being at risk of illness (Korin et al., 2013; Sasaki et al., 2022). These findings stress the importance of a comprehensive approach integrating workplace training and tailored interventions to mitigate the risks of NIHL in service industry settings. Additionally, recognising and addressing gender-specific needs in the planning and delivery of hearing education programs can enhance the effectiveness of these strategies and ensure inclusivity.

Despite its valuable contributions, this study has several limitations worth considering for future research. The small sample size and geographic focus on a single town limit the generalisability of the findings to other baristas and cafés in Malaysia. The use of an online questionnaire, requiring baristas to scan a QR code, likely reduced the response rate due to their busy schedules. Alternative distribution methods, such as WhatsApp or email, may improve participation.

This study used the NIOSH SLM app for area measurement, which, although, validated, does not offer the precision calibration of Class 1 and 2 SLMs. Future studies should address this by employing standardized devices compliant with ANSI and IEC standards to enhance the applicability of the findings. Personal dosimetry is recommended to assess the cumulative noise impact on the worker, helping to determine if they are being exposed to potentially harmful noise levels.

## CONCLUSION

This study determined that although café noise levels measured during peak hours were below hazardous thresholds, baristas demonstrated limited knowledge and low perceived risk of hearing loss. This highlights the need for targeted hearing health education to promote awareness and protective practices, even in relatively low-noise environments.

Future research should consider using standardized noise measurement instruments and personal exposure monitoring to enhance accuracy. Integrating perspective, given the limited knowledge and low perceived risk of hearing loss among baristas, reviewing noise exposure standards for service industries and integrating gender-sensitive approaches into hearing conservation programs might be worth considering in creating safer and healthier workplaces.

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