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Road Traffic Noise Annoyance and Cardiovascular Disease Risk in Population: A Case Series Study in Kota Bharu, Malaysia

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Abstract
Noise pollution can cause annoyance, significantly threatening the population's health and well-being. This study aimed to find an association between road traffic noise exposure and cardiovascular disease (CVD) risk among residents in Kota Bharu, Malaysia. This descriptive study used a case series approach and surveyed 34 residents in selected residential areas near main roads. An adapted questionnaire was distributed to residents using a purposive sampling method. Questions related to sociodemographic information, self-reporting about CVD, and road traffic noise assessment were asked to investigate the underlying risk factors for CVD. The average score of CVD assessment was classified as moderate risk. No significant association between noise annoyance and CVD was found using multiple linear regression. However, the association between cardiovascular risk and sociodemographic variables, particularly the length of residency at the current address, was statistically significant. Although noise annoyance was not associated with CVD, the length of residency could mediate CVD risk as those living longer in residence might be less vulnerable to the noise. Future longitudinal studies are recommended, which include a noise exposure assessment with a larger sample.

Keywords: CVD, cardiovascular risk, noise annoyance, noise exposure, road traffic noise

Introduction

Environmental noise could be defined as unwanted or harmful outdoor sounds that human activities generate, which include noise from roads, railways, airports, and industrial sites.[1] Noise has been recognized as a pollutant by the World Health Organization since 1972.[2] A main agent resulting in environmental loss and degraded quality of life in a metropolis is noise pollution.[3] Europeans spend approximately 90% of their time indoors and almost 60% at home.[4] Similar to the Asia Pacific region, most of the population preferred to stay at home despite the lockdown measures had been lifted during the COVID-19 pandemic.[5] Over 70% of the Malaysian population preferred to stay at home compared to those who chose to go out.[5]

Road traffic noise is harmful to the health of urban residents, especially at night. The major concern of environmental noise exposure in cities is sleep disturbance as the nighttime noise is more pervasive in urban areas, which reduces the quality and quantity of sleep even at a low level of noise.[6] Outdoor road traffic noise exposure has affected many residents' sleep quality and convenience.[7] The nighttime road traffic noise, even at a level lower than daytime exposure, contributes to oxidative damage, elevated stress hormone levels, and fragmented sleep.[7] These variables may contribute to the development of high blood pressure and vascular malfunction (endothelial dysfunction).[8]

Besides, the misclassification of daytime noise exposure in residential areas is higher than nighttime noise as people are more likely not to be at home.[9] A prospective cohort study among 2,497 residents in the region of Basel, Switzerland, found that noise annoyance and sleep disturbance were strong mediators for the effects of road traffic noise on the health-related quality of life.[10] Any reaction to noise annoyance is mediated by sleep disturbance, communication, and activity, as well as associated emotional and cognitive reactions. These affect endocrine (e.g., increased concentrations of cortisol and catecholamine) and autonomic (sympathetic) systems.[11] This may lead to modifications in blood pressure regulation and glucose and lipid metabolism, all of which increase the risk of cardiovascular disease (CVD).[7]

Overall, exposure to road traffic noise could increase CVD risk for several influential factors: sociodemographic

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characteristics (age, sex, and socioeconomic status), health status, and lifestyle.[12] Therefore, determining the noise annoyance of residents will serve as a proxy for the subjective assessment of road traffic noise exposure in the residential areas observed. This method has been applied in previous studies,[13-15] as annoyance is a symptom of emotional stress, which is a major risk factor for the development of atrial fibrillation with a strong association with other CVDs, including coronary artery disease and hypertension.[16] Furthermore, noise sensitivity is a sign of vulnerability to environmental stressors, and the highly-sensitive persons are more likely to develop illness when exposed to environmental noise.[17]

Kota Bharu, a capital city of Kelantan state on the East Coast of Peninsular Malaysia, may face critical noise pollution issues in the near future due to the growing population, rapid urbanization, improper road planning, and increasing traffic volume in the city. The problem may become worse for no proper integration between land use and road planning in Kota Bharu to reduce the impact of environmental noise pollution. Road traffic noise, particularly higher vehicular traffic and vehicle speeds, causes problems for local residents. This study aimed to assess the noise annoyance perceived by the residents as a proxy for road traffic noise exposure and its association with the CVD risk in Kota Bharu, Malaysia.

This study is the latest in determining the causal impact of noise annoyance on CVD risks in the small regions to add to the existing literature on the epidemiological relationship between noise and health in Malaysia rather than simply assessing the level of noise exposure level. Therefore, the outcomes would indicate whether safety measures or certain actions are adequate to deal with the problem of road traffic noise among the neighborhoods impacted, such as the monitoring of noise level, noise barriers, building sound insulation, the enforcement of noise regulations and policies, and the monitoring of speed limit around the residential area.

Method

This study applied descriptive research design with case series as the methodological approach. Residents living in a residential area in Kota Bharu near main roads were recruited to participate in this study that was conducted in January-July 2020. The residential area locations selected were Taman Seri Pengkalan Chepa, Taman Seri Tambahan Pengkalan Chepa, and Bandar Baru Kubang Kerian due to facilities near the residential areas (within 1 km). The commercial areas consist of many restaurants and a city airport at Pengkalan Chepa. At the same time, Universiti Sains Malaysia Hospital, schools, and shopping centers are located in Kubang Kerian, which could be considered a point of attraction in Kota Bharu. All of these activities might contribute to noise pollution in Kota Bharu.

The population in this study was residents living in the selected residential areas in Kota Bharu close to the main roads, approximately 100 meters away, as used in the previous study.[18] However, distance estimation was done using the Google Maps app and observation during the site survey. The inclusion criteria included those exposed to road traffic noise (living close to a main road within 100 meters) and individuals aged 18 years and older who understood Malay or English language. Based on the 2019 National Health and Morbidity Survey, Malaysians aged 18 years and older were estimated to have a high potential of getting CVD symptoms.[19]

More than one respondent or representative per household was allowed to participate in this study. Illiterate householders were excluded from the study. A priori power analysis determined the minimum sample size required for the study hypothesis testing. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = 0.05$, was $N = 55$ for linear regression. However, only 34 participants were obtained to participate in this study through purposive sampling.

This study applied an adapted questionnaire as an instrument to answer the aims of study. The questionnaire consisted of three parts. The first part consisted of self-developed questions to gather sociodemographic information, such as sex, race, household income, occupation, duration of living at current address (years), and current address. Household income and occupation would indicate the socioeconomic status of the respondents. A previous study found that deprived groups suffered a low economic status burden and were vulnerable to higher noise exposure.[20] The second part contained questions about the CVD risk factors and records. The third part comprised road traffic noise assessment-related questions. The modified questionnaire was reviewed by the field experts. In terms of the internal consistency of the questionnaire items, Cronbach's alpha value obtained was 0.811, thus indicating that the questionnaire was reliable.

Cardiovascular Risk Assessment Questionnaire (CRAQ)-related questions in the second part were adopted and modified from the prior study. The questionnaire originated from Australia and New Zealand Health World.[21] This CRAQ tool was used as it has a multiple-choice questionnaire designed to assess an individual's CVD risk, which is structured and easy to comprehend and respond to for the target local community. The questionnaire provided assignment of a "risk score," either positive, neutral, or negative to each potential support item, based on how each associated element contributed to or reduced CVD risk in this study. The questionnaire had two parts: the first part must be filled in by a patient or subject, while the second part must be filled in by a physician.

However, this study only took the first section of the questionnaire. Only the patient's self-report section was used in this study, as not all participants had access to a doctor's or their medical records. The CRAQ part comprised seven subscales: risk associated with age younger than 30 years to older than 70 years (score range: 0 to 140), CVD records (score range: 0 to 250), CVD and diabetes in family (score range: 0 to 45), healthy or unhealthy lifestyle (score range: -35 to 150), including physical activity, smoking, alcohol abuse, passive smoking, and environment, stress and its management (score range: -19 to 330), sleep duration and its disorders (score range: 0 to 29), and healthy or unhealthy nutrition (score range from -23 to 48). The CVD outcome was measured based on the total cardiovascular risk score divided into four categories: low (-88 to 100), moderate (101 to 220), high (221 to 350), and severely high (351 and more). The higher the score, the higher the CVD risk. Negative scores indicated a reduced effect of CVD risk, such as due to a healthy lifestyle or diet.

Moreover, the last part of the questionnaire was road traffic noise assessment, adopted and modified from the International Commission on Biological Effects of Noise annoyance ratings.[22] The road traffic noise exposure measures used a 0-10 scale according to the magnitude of annoyance to the road traffic noise that the residents perceived while staying at home. 0 indicated "not all annoyed," and 10 was categorized as "extremely annoyed." The questions also included when the road traffic noise was annoying, disruptive, or disturbing at home during the morning, afternoon, and evening on weekdays and weekends.

Furthermore, the respondents were asked about the action taken and any suggestions to reduce the noise at home. Due to the unexpected COVID-19 pandemic, the road traffic noise measures could not be taken. Therefore, this study assessed the noise exposure among the residents through perceived noise annoyance. Although community activities were restricted during the COVID-19 pandemic, which indirectly reduced the road traffic noise level, this study required the residents to self-report their perceived annoyance based on overall (past and current) experiences living in their residential areas.

The questionnaire was distributed to the residents by hand in the selected residential areas to obtain the larger number of study participants. The surveys were distributed in the evening of weekdays after working hours. Respondents were asked to participate in this study if they were accessible and met the inclusion criteria. Respondents who needed some assistance to answer the questions were guided without trying to influence their answers. Each respondent had a participant code number recorded on the questionnaire form to ensure that the data were anonymized. In addition, the respondents provided and filled out the written consent form upon answering the questionnaire as their approval to join the study and to ensure the confidentiality of their personal information.

The data analysis used the SPSS version 24.0, licensed under the Universiti Sains Malaysia. The distribution of respondents for sociodemographic information was analyzed descriptively and presented in frequency and percentage, while CRAQ was in mean and standard deviation, and noise annoyance used a median and interquartile range. Data normality was checked using the Kolmogorov-Smirnov test. The Pearson correlation test was used to determine the relationship between cardiovascular risk, noise annoyance, and length of residency. Inter-relationships among variables could significantly influence the interpretation of regression model findings in reference to prior expectations, although not nearly as high as strong collinearity.

Multicollinearity might affect the size and the standard error of the regression coefficients related to those collinear variables, which could be difficult to interpret.[23] The association between the CVD and noise annoyance was explored using simple linear regression since the outcome of this study was analyzed as a mean score. The statistical relationship between CVD risk, sociodemographic, and other potential risk factors, such as age, CVD record, family history, lifestyle, stress, sleep, and diet risks, was analyzed through multiple linear regression tests.

Results and Discussion

Table 1 shows the distribution of respondents by demographic information, with a total of 34 respondents. Most participants were female (61.8%), Malay (88.2%), and under 30 and 50-69 years old, with an equal percentage (35%). The mean age of respondents was 37 years. However, most respondents were at the age of under 30 years, in which the percentage for this age group was the highest in this study. Most respondents were young residents for only one representative per household preferred by the occupants to answer the questionnaire, and most likely they were those who could read and write well.

In addition, the highest percentage (44%) for household income was obtained from respondents receiving worth Malaysian Ringgit (MYR)1,000-4,999 monthly, which fell under the first quartile. Based on the results, the respondents' household income mostly fell under the first quartile. For decades, socioeconomic status has shown a consistent inverse relationship with CVD in most industrialized countries in the West, in which disadvantaged groups experience a higher

Table 1. Distribution of Respondents Based on Demographic Information Characteristic (n = 34)

Variable	Category	n (%)
Sex	Male	13 (38.2)
	Female	21 (61.8)
Age (years)	Under 30	12 (35.3)
	30 – 34	4 (11.8)
	35 – 39	5 (14.7)
	40 – 44	-
	45 – 49	1 (2.9)
	50 – 54	4 (11.8)
	55 – 59	2 (5.9)
	60 – 64	5 (14.7)
	65 – 69	-
	70 – 74	1 (2.9)
	75 and over	
Race	Malay	30 (88.2)
	Chinese	4 (11.8)
Household income	Lower than MYR 100	6 (21.4)
	MYR 1,000 – MYR 1,999	6 (21.4)
	MYR 2,000 – MYR 2,999	5 (17.9)
	MYR 3,000 – MYR 3,999	3 (10.7)
	MYR 4,000 – MYR 4,999	1 (3.6)
	MYR 5,000 – MYR 5,999	2 (7.1)
	MYR 6,000 – MYR 6,999	1 (3.6)
	MYR 7,000 – MYR 7,999	1 (3.6)
	MYR 8,000 – MYR 8,999	1 (3.6)
	MYR 9,000 – MYR 9,999	1 (3.6)
	MYR 10,000 and greater	1 (3.6)
Length of residency	Less than 1 year	3 (9.1)
	1-10 years	8 (24.2)
	More than 10 years	22 (66.7)
Type of house	Semi-detached or townhouse or terrace or villa	17 (50.0)
	Other (Shophouse)	17 (50.0)

Note: MYR = Malaysian Ringgit

risk of CVDs.[24] Several studies have agreed that low-income individuals are at higher risk of developing CVD.[25,26] Rosengren et al.[27] studied 20 low-, middle- and high-income countries in total and found a high level of CVD risk in low social class associated with low education levels.

More than half (66.7%) of the residents had lived more than ten years at their current residence. Half of the them lived in a terrace house, and another half stayed at a shophouse. Based on the survey, most respondents were not exposed to occupational noise as their occupations had a low exposure to high noise levels. The respondents' occupations included retail businessmen, students, housewives, clerks, educators, and managers. This study revealed that most respondents lived in their current residence for more than ten years. Therefore, these respondents might be more resistant to noise in their surroundings.

Accordingly, the road traffic noise emission would no longer affect their daily basis since they had lived at their house for a long time. A previous study found that the population living close to high-traffic roads exceeding 70 dBA did not consider road traffic noise an annoying factor.[28] This might be due to such insensitivity of theirs to adverse road traffic noise conditions as they do not intend to change their residence.[28] However, some of them could also feel annoyed by road traffic noise since they had experienced gradual exposure to noise, which might be higher than before for the urban development in Kota Bharu.

Most respondents were annoyed by the road traffic noise, with a median of six on a ten-point scale. Due to study limitations, the road traffic noise measures could not be taken. Therefore, this study used the noise annoyance scale as an indicator for the residents' exposure to the road traffic noise. Most respondents preferred motorcycles (70.6%) as the primary source of road traffic noise around their residential area, followed by private cars (48.5%). A study in Indonesia shared the same findings.[29] Private cars were the second highest to be selected as the source of road traffic noise in the survey, as stated in several studies in Malaysia.[30-32] The respondents also felt disturbed by the engine revving and fast-moving vehicles; a previous study called this vehicle noise.[30]

On the other hand, the respondents did not think that road traffic noise interfered with home life, such as listening to the music, having a conversation, reading, relaxing, studying, and spending time outdoors. A study in Shah Alam, Malaysia, also revealed that the nearby residents' daily activities and health conditions were not affected by the noise level from the traffic.[32] Several causes are determined to explain a variety of noise annoyance levels among individuals. The first is the degree of susceptibility to noise. Generally, everyone has their level of vulnerability to noise. Therefore, some people could stand at a high level of sound. Second, humans are immune to the noise around them. The third is the house location. If the house is surrounded by large trees, the noise from traffic might be reduced since trees serve as a natural sound barrier.[33] Therefore, indirectly, the occupants would have lesser exposure to the noise.

However, almost half of respondents admitted that they had difficulty hearing conversations during phone calls (41.2%), while 32.4% reported that their sleep had interfered. Most respondents stated that road traffic noise caused bothersome, annoyance, or disturbance at home and at night on weekends (61.8%) and weekdays (73.5%). The respondents managed to reduce the noise even though most (56.5%) claimed the action did not solve the problem. (Table S1).

The CVD risk assessment scores (mean±SD) are shown in Table 2. The mean total score of cardiovascular risk is 125.65±72.78. This result is categorized as moderate risk (101 to 220) according to CVD risk classification. Additionally, risks related to cardiovascular history and stress were moderate. The mean lifestyle score (17.71±21.76), including the residents' environment, was recorded as moderate risk based on the risk classification. The distribution of each CVD risk of the respondents is shown in Table S2 of the Supplementary Files.

Although the prevalence of noise annoyance was only moderate, some residents had initiatives to reduce the noise by modifying inside or outside their houses, soundproofing their bedrooms, blocking the noise by wearing earphones, asking for legal advice, filing a complaint or making a police report, and warning or giving an advice to the driver who made the noise. Awareness of such actions might also reduce the exposure to road traffic noise and indirectly lessen the perceived annoyance level. The awareness might also explain the moderate risk of CVD among the study population. Consequently, the CVD risk might be attributed to the noise exposure as a subfactor studied in the lifestyle aspect was the house location near the main road.

The relationships between age, CVD records, family records, lifestyle, stress, sleep, nutrition, total risk, noise annoyance, and length of residency using the Pearson correlation test. This test measured the strength of association between the exposure and outcome of interests, also potential confounding factors of CVD. However, based on the correlation matrix, only moderate correlations were found between age and nutrition ($r = -0.52$) and total CVD risk with CVD ($r = 0.605$) and family records ($r = 0.569$). The length of residency also has moderate correlations with age ($r = 0.507$), family records ($r = 0.452$), and total CVD risk ($r = 0.699$) (Table S3). Thus, the results indicated that only few predictors included in the study had moderate multicollinearity, and no covariate was correlated with noise annoyance.

Table 2. The Cardiovascular Disease Risk Assessment Score

Variable (Score Range)	Mean (SD)	Cardiovascular Disease Risk Category
Age risk (0 to 140)	37 (46.97)	Not a modifiable risk factor
Cardiovascular disease record risk (0 to 250)	25 (51.12)	Low: (0 to 30) Moderate: (31 to 50) High: (51 and above)
Family record risk (0 to 40)	15 (14.77)	Not a modifiable risk factor
Lifestyle risk (-35 to 150)	17.71 (21.76)	Low: (-35 to -10) Moderate: (-9 to 21) High: (22 and above)
Stress risk (-19 to 330)	25.53 (28.26)	Low: (-19 to 20) Moderate: (21 to 40) High: (41 and above)
Sleep risk (0 to 29)	4.97 (2.56)	Low: (0 to 5) Moderate: (6 to 11) High: (12 and above)
Nutrition risk (-23 to 48)	1.74 (6.91)	Low: (-19 to 6) Moderate: (7 to 13) High: (14 and above)
Total cardiovascular risk	125.65 (72.78)	Low: (-88 to 100) Moderate: (101 to 220) High: (221to 350) Very high: (351 and above)

Note: SD = Standard Deviation

Table 3. Association Between Noise Annoyance and Cardiovascular Disease Risk

Cardiovascular Disease Risk		Coefficient (95% CI)			
		Model I	Model II	Model III	Model IV
Noise annoyance		-0.038 (-9.640; 7.820)	-0.198 (-11.830; 2.690)	-0.005 (-0.800; 0.500)	-0.003 (-0.617; 0.464)
Sociodemographic	Age	-	-0.015 (-0.650; 0.610)	-	-0.016 (-5.420; 0.902)
	Sex	-	-0.084 (-60.100; 36.700)	-	-0.001 (-5.548; 5.108)
	Race	-	0.045 (-71.800; 89.400)	-	-0.002 (-0.630; 0.546)
	Household income	-	-0.145 (-11.100; 4.100)	-	0.016 (-1.960; 5.671)
	Length of residency	-	**90.313 (48.100; 132.500)	-	0.000 (-1.190; 1.183)
Cardiovascular risk factors	Age	-	-	**0.638 (0.937; 1.040)	**0.676 (0.922; 1.022)
	CVD record	-	-	**0.723 (0.987; 1.073)	**0.786 (0.960; 1.037)
	Family record	-	-	**0.201 (0.846; 1.130)	**0.187 (0.782; 1.053)
	Lifestyle	-	-	**0.275 (0.824; 1.013)	**0.307 (0.877; 1.016)
	Stress	-	-	**0.402 (0.961; 1.109)	**0.393 (0.945; 1.079)
	Sleep	-	-	*0.036 (0.180; 1.857)	**0.060 (1.146; 2.549)
	Nutrition	-	-	**0.069 (0.180; 1.857)	**0.076 (0.552; 0.995)
Adjusted R^2		-0.030	0.571	0.995	0.999

Notes: CI = Confidence Interval, CVD = Cardiovascural Disease, Significant at *p-value <0.05, **p-value <0.001, Statistical test: Multiple Linear Regression, Model I = Unadjusted Model, Model II = Adjusted with Sociodemographic Factors, Model III = Adjusted with Cardiovascular Risk Factors, Model IV (Fully Adjusted Models) = Adjusted with Sociodemographic and Cardiovascular Risk Factors.

Table 3 shows the association between noise annoyance and the CVD risk in the unadjusted (Model I, p-value = 0.833), partially adjusted (Model II, p-value = 0.204 and Model III, p-value = 0.700), and fully adjusted (Model IV, p-value = 0.766) models. No significant association was found between the noise annoyance of each model and the CVD risk. Model II was adjusted with the sociodemographic factors; only the duration of residence (years) at the current address (coefficient: 90.31, 95% CI = 48.1; 132.5, p-value<0.001) was significantly associated with the CVD risk. Generally, 57.1% of the CVD risk variance was explained in Model II (R^2 = 0.571; F = 7.307; p-value = 0.001).

While for the model adjusted with the CVD risk factors (Model III), all the risk factors included (age, CVD records, family records, lifestyle, stress, sleep, and nutrition) were strongly associated with cardiovascular risk. The explained variance was 99.5% (R^2 = 0.995; F = 1047.24; p-value<0.001). Similar to the fully-adjusted model (Model IV), all the CVD risk factors were associated with CVD (p-value<0.001). However, the length of residency was no longer significant. This model was able to explain 99.9% of the variance of the total CVD risk factors (R^2 = 0.999; F = 1332.57; p-value<0.001).

This study showed no significant association between noise annoyance and CVD risk in the unadjusted and adjusted models. Furthermore, sleep quality and noise annoyance might not be considered as adverse effects of noise since most residents were moderately annoyed and did not interfere with the road traffic noise. A study in Norway and the United Kingdom supported these results, stating that road traffic noise (mean Lden) was not associated with either incident cardiovascular, ischemic heart disease, or cerebrovascular disease.[34] However, a study in Taiwan found an association between the hypertension prevalence and road traffic noise exposure, even at low and mid-level frequencies.[35] This frequency level is reportedly sensitive to the human auditory system.[35] Non-significant association in this study might be due to selection bias (volunteer bias) in the recruitment of study participants, reflected in the variability of the exposure and the outcome measured.

The potential confounders for the CVD risks analyzed in this study were sex, race, household income, length of residency, and type of house. The CVD had a significant association with the length of residency (years) at the current address; however, no significant relationship was found with other sociodemographic factors. More than half of the residents had lived in their current residence for more than ten years. Besides, some participants had lived in their residences for one to ten years. This finding is similar to a previous study in Taichung, Taiwan,[35] but contradicts a study in Sweden that did not find an increased risk of hypertension among those with a length of residency period of greater than and equal to five years.[36]

Some circumstances limited the conduct and findings of this study. For the CRAQ, this study only used the first part of the questionnaire, which lowered the respondent's CVD risk score more than the total risk calculation and categories. The whole part of the questionnaire should be applied in future studies to provide more precise information on the CVD risk distribution. Besides, the sample size of this study was small, so it was really challenging to get a response from potential study participants through an email invitation approach. This study involved a limited number of residential areas and respondents due to most residents' time constraints and unavailability during the walkthrough survey. However, the power analysis had been conducted for the acquired sample size (34 respondents). Thus, the obtained sample size suggested a ~60% and 30% probability of not encountering Type II errors in the simple and multiple linear regression analysis, respectively. Eventually, the exposure misclassification might occur since the current study used noise annoyance as a proxy for noise exposure level.

Conclusion

A significant association between noise annoyance and CVD cannot be determined in this study. However, the length of residency at current address significantly predicts noise annoyance among the residents. This indicates that the residents staying longer in the current residential area have been less sensitive to the noise and unaware of such invisible pollutant, which may silently result in some long-term health problems. Future studies, including noise exposure assessment with a larger population sample, are recommended to determine better causal relationships between noise and CVD.

Abbreviations

CVD: Cardiovascular Disease; CRAQ: Cardiovascular Risk Assessment Questionnaire; MYR: Malaysian Ringgit.

Ethics Approval and Consent to Participate

This study was assessed by the Human Research Ethics Committee of Universiti Sains Malaysia (number: USM/JEPeM/19110719). This study was conducted based on the specified criteria which include explaining the study benefits and the respondents' rights, protecting the privacy of respondents, as well as upholding aspects of fairness and the principle of openness by explaining research procedures and informed consent. Written informed consent was given to participate.

Competing Interest

The authors declared no significant competing financial, professional, or personal interests might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

Data and materials are available for sharing according to procedures and regulations. The supplementary files can be accessed here.

Authors' Contribution

FN and NHMN designed the study, conducted quantitative data analyses, and drafted the manuscript. NHMN collected samples. FN gave feedback and revised the manuscript. All authors read and approved the final manuscript.

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