ORIGINAL ARTICLE

Road Traffic Noise and Health-Related Quality of Life

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ABSTRACT

Background: Traffic noise is an increasing problem in our modern society and the dominant source of noise in urban environments. There is limited data on the impact of noise on health in the local environment despite the increase in vehicular traffic on Nigeria's roads. **Objective:** This study seeks to assess the effect of road traffic noise annoyance on health-related quality of life of the citizens. **Method:** This is a cross-sectional study that employed a multi-stage sampling technique. Three hundred and eighty respondents were selected in Ibadan, Nigeria. Using a GPS-linked mobile app, residential homes situated between 50m and 2km from major roads were identified. Estimates of noise levels were derived from manual traffic counts using an online noise calculator. The abbreviated World Health Organization Quality of Life questionnaire was used to assess the quality of life. **Results:** Respondents who lived in high-noise areas were exposed to an average road traffic noise level of 71 – 77dB, values which exceeded the WHO recommendations of 50–55 dB. Moreover, annoyance caused by traffic noise was more prominent in high-noise areas compared to low-noise areas. A significant association was found between health-related quality of life across the four domains and annoyance due to traffic noise and traffic fumes in both high-noise and low-noise residential areas. **Conclusion:** This study highlights the need for enforcement of regulatory measures to control high road traffic noise in residential areas.

Key words: Noise, quality of life, low-noise area, high-noise area, WHO Quality of Life

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Introduction

Noise is a sound that is too loud, unpleasant, or disturbs the listener.[1] Noise is derived from the Latin word nausea, implying 'unwanted sound' or 'sound that is loud, unpleasant, or unexpected. It can be defined as the wrong sound, in the wrong place, and at the wrong time.[2] Exposure to unwanted sound is increasing globally due to population growth, urbanization, and technological developments.[1] An expanding body of scientific evidence links environmental noise to health problems.[3] Chronic noise exposure can compromise health, yet a significant portion of the population is exposed to night-time sound pressure levels that can be considered detrimental to sleep.[4] The major source of environmental noise is road traffic, followed by aircraft and rail noise.[4] Disability-adjusted life years (DALYs) due to road traffic noise accounts for 21.8% of the total burden of disease due to environmental pollutants.[5] DALYs due to road traffic noise has increased steadily between the years 2000 and 2019, and it is projected that it will continue to grow.[5]

Direct health effects of noise include hearing loss and cardiovascular effects, while indirect health effects include annoyance and sleep disturbance and are

often used as an outcome source of noise annoyance.[6] Annoyance is defined as a scalar property denoting noise-induced stress, either facilitating the development of health effects via endocrine processes or as a health effect in its own right.[7] Estimates of annoyance due to road traffic noise have been obtained internationally using social surveys, with European data suggesting that between 10% and 35% of urban dwellers are annoyed by road traffic noise.[8]

Quality of life (QOL) is defined as "an individual's perception of their position in life in the context of the cultural value system in which they live and about their goals, expectations, standards, and concerns,[1"] emerged in the 1970s as to supplement traditional morbidity and mortality outcomes. QOL is a global measure, broader than health status, inherently subjective, and of all aspects of life important to the person.[9] Some environmental noise studies have utilized QOL measures to quantify and compare community responses to different noise sources,[7,10] with the general observation that increasing noise exposure is associated with decreased QOL. There is limited data on the impact of traffic noise on health in local settings despite the increase in noise generated by traffic. Therefore, this study assesses road traffic noise and health-related quality of life in Ibadan, Southwest Nigeria.

Methods

The respondents were individuals aged 18-58 years who live in the selected major traffic areas (Mokola, Sango, Bodija/ojurin and University of Ibadan /Agbowo) in Ibadan North Local Government, Ibadan. The study recruited participants in both high-noise areas and low-noise areas. Areas within a radius of 0.5 km of Mokola, Sango, the University of Ibadan, Agbowo, Bodija Market, and Ojurin were tagged as high-noise areas, while those at least 2 km away from the same area were tagged as low-noise areas. Respondents who met the inclusion criteria and consented were recruited randomly and asked to complete the study questionnaire with assistance (if required) from a research staff.

A standardized questionnaire used in the "Wellbeing and Neighbourhood Survey 2012,[11] was adapted for the study. The questionnaire contained 38 items categorized as: Health-Related Quality of life (HRQOL) (26 items), amenity (2 items), environmental annoyances (2 items), demographic information (7 items), and noise sensitivity (1 item). To measure HRQOL, the study employed the short form of the World Health Organization Quality of Life Scale (WHOQOL-BREF). The WHOQOL is divided into four domains: physical health (7 items), psychological well-being (6 items), social relationships (3 items), and environmental factors (8 items). Two additional items assessed the overall quality of life and self-rated health. The questions asked included, how would you rate your quality of life? item was scored on a 5-point Likert scale, ranging from *1 (very poor) to 5 (very good)*. How satisfied are you with your health item was scored on a 5-point Likert scale, ranging from *1 (very dissatisfied) to 5 (very satisfied),* where a low score corresponds to a negative evaluation of that aspect of life, and a high score corresponds to a positive evaluation. Out of the two annoyance items, one asked about annoyance due to road traffic noise, and the other item asked about annoyance from traffic fumes. The specific questions include thinking about the last six months, how annoyed are you about noise from traffic noise and noise from another source? Items were scored on a 5-point Likert scale, ranging from *1 (Not annoyed at all) to 5 (extremely annoyed)*. The annoyance with noise items was based on recommendations issued by the International Commission on the Biological Effects of Noise.[11]

Estimates of noise levels were derived from traffic counts using an online noise calculator,[12] for computing noise levels. An average speed limit of 50km/h was assumed. The distance between road traffic and dwelling homes was measured using a GPS distance app finder.[12] The noise level was commuted in decibels (dB) at the given distance (50m and 2km) from the road. Manual counting was carried out at the selected major traffic points between the hours of 7:30 am to 8:30 am, 3:30 pm to 4:30 pm, and 4:30 pm to 5:30 pm, from Monday to Saturday.[13] The counting was based on visual observation, and the number of vehicles was assessed per hour; all private cars, commercial buses and taxis, motorcycles, tricycles, and heavy-duty vehicles were counted at intersections of the road and were recorded in a dedicated book note.

All analyses were conducted using the Statistical Package for Social Sciences software (SPSS; version 20), and total scores for each of the four WHOQOL-BREF domains were computed. Descriptive statistics was used to compute the noise sensitivity scores, and independent t-tests were used to test for the difference

between the WHOQOL mean score of the overall quality of life, physical health, psychological health, social health, and environment across the low and high-noise area and correlation analysis was used to test for the associations between WHOQOL and annoyance caused by traffic fumes and noise both overall and in the high noise area and low noise area.

Ethical Clearance to conduct this study was obtained from the Oyo State Ethical Review Committee with the Ethical approval number (AD 13/479/1649A). Written informed consent was obtained from the respondents.

Results

The total number of respondents recruited for this study was 380, with 190 respondents recruited from low and high-noise areas each. In both study areas, the proportion of females was higher, with 63.7% in the low-noise areas and 54.7% in the high-noise areas. The respondents ages ranged between 18 to 58 years in low and high noise areas with mean ages of 34.5±14.2 years and 34.1±12.5 years, respectively.

As shown in Figure 1, 8.4% and 13.2% of the respondents in the low and high-noise areas had medical illness. Almost half of the respondents in the low-noise area reported that they were not sensitive to noise, while 42.6% of the respondents reported that they were very sensitive to noise in the high-noise area (see Figure 1). A larger portion of the respondents in high-noise area had been living in the area in the past one to ten years compared to the low-noise areas. In high-noise areas, a smaller number of respondents reported having a good QOL compared to low-noise areas. The majority of respondents in high-noise areas were fairly dissatisfied with their health. (See Figure 1)

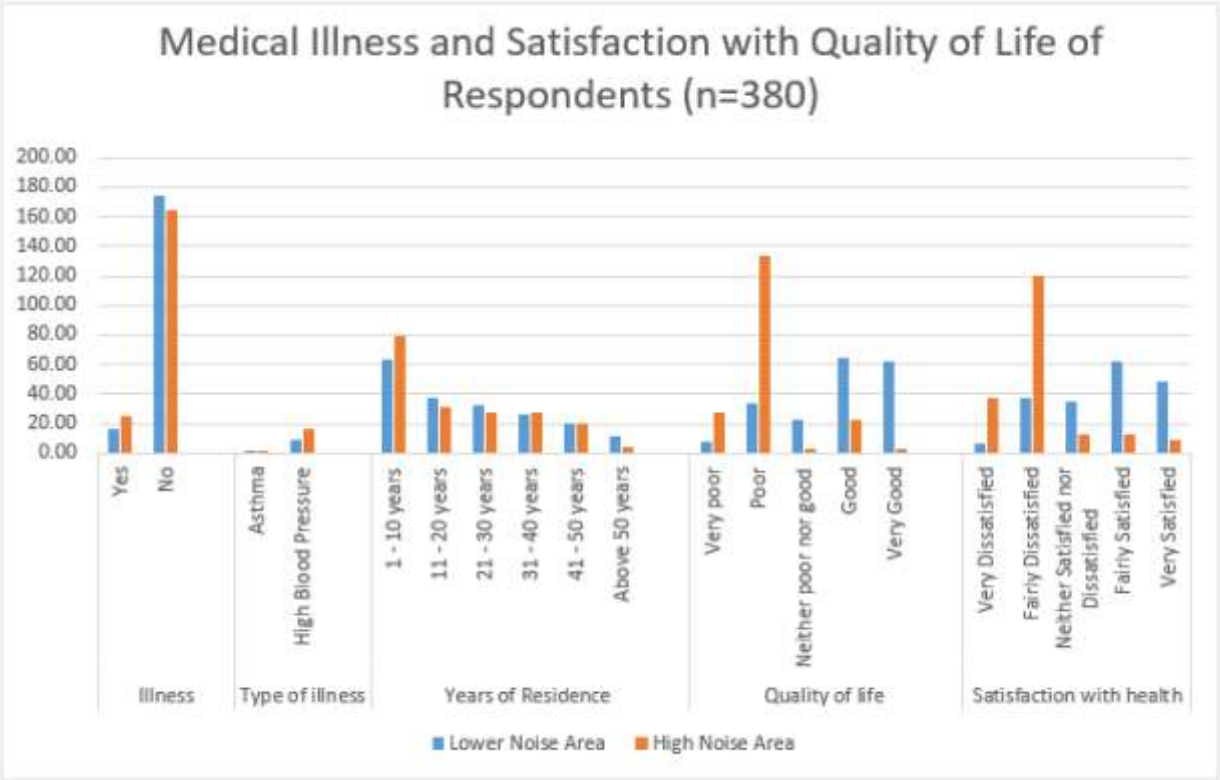

Figure 1: Medical Illness and Satisfaction with Quality of Life of Respondents (n=380)

Noise-sensitive profile

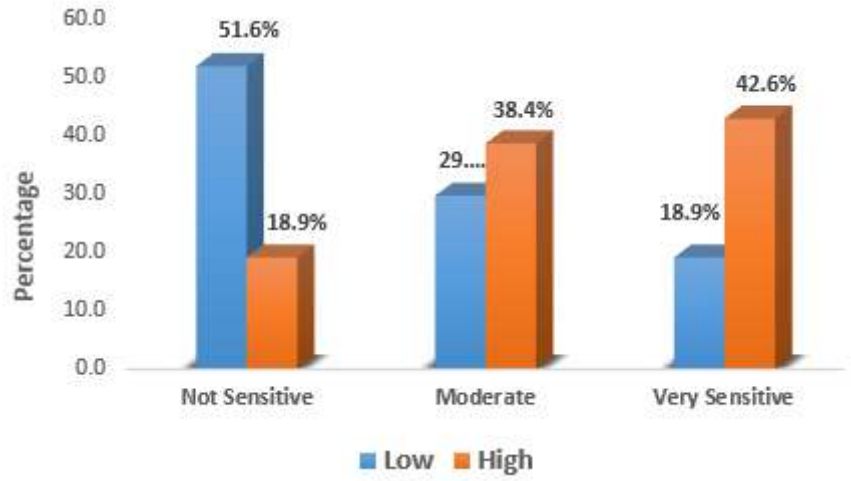

Figure 2: Noise sensitivity of Respondents

A low sensitivity to noise was observed in low noise area compared to a very high noise sensitivity in high noise area (Figure 2). A significant negative correlation with the overall quality of life (QOL) was observed in this study, this suggests that higher levels of road traffic noise are associated with lower QOL, (Figure 2). There is a significant negative correlation between road traffic noise and all the domains of the WHOQOL suggesting that higher levels of road traffic noise were associated with lower levels of health and well-being across all four domains of the WHOQOL. Conversely, noise sensitivity is a significant positive correlation with road traffic noise and a significant negative correlation with the overall QOL and all the domains of the WHOQOL. This suggests that respondents who were more sensitive to noise in the entire sample tend to have exposure to higher levels of road traffic noise and report lower levels of health and well-being.

In the low noise area, correlation analysis revealed a statistically significant negative association between noise sensitivity and quality of life across the two domains (physical and social, $p<0.01$), Table 1. In high noise areas, correlation analysis revealed that there was a statistically significant association between sensitivity and quality of life with a significance value of ($P<0.01$) across the four domains of the WHO HRQOL.

Table 1: Association between World Health Organization Health-Related Quality of Life and Noise Sensitivity in both Low Noise Area (n=190) and High Noise (n=190)

Noise Sensitivity	Physical	Psychological	Social	Environment
Pearson's r (Low Noise Area)	-0.210**	-0.007	-0.175*	-0.108
P-value	0.004	0.920	0.016	0.139
Pearsons's r (High Noise Area)	-0.333**	-0.336**	-0.250**	-0.187*
P-value	0.001	0.001	0.001	0.010

There was an observable contrast in the levels of annoyance experienced by residents in low-noise and high-noise areas. In low-noise areas, the majority of respondents were slightly annoyed by air pollution and noise from traffic whereas in the in high-noise areas, a significant portion of respondents were extremely annoyed by both air pollution and noise from traffic, Table 2.

There was a visible correlation between road traffic noise, quality of life, and various health domains. For instance, increased road traffic noise is seen to be associated with poorer quality of life, physical

health, psychological health, social health, and environmental health. A similar relationship also exists with road traffic noise and noise sensitivity. The mean values indicate moderate levels of these variables, with noise sensitivity being slightly below the midpoint.

Table 2: Respondents' Level of Annoyance about Air Pollution and Noise in the Neighbourhood

	Not annoyed at all n (%)	Slightly Annoyed n (%)	Mildly Annoyed n (%)	Very Annoyed n (%)	Extremely annoyed n (%)
Low Noise Area(n=190)					
Air pollution from traffic	46 (24.2)	105 (55.3)	27 (14.2)	5 (2.6)	7 (3.7)
Noise from traffic	66 (34.7)	86 (45.3)	12 (6.3)	11 (5.8)	15 (7.9)
High Noise Area (n=190)					
Air pollution from traffic	34 (17.9)	22 (11.6)	6 (3.2)	49 (25.8)	79 (41.6)
Noise from traffic	24 (12.6)	23 (12.1)	27 (14.2)	34 (17.9)	82 (43.2)

The results show that there was a statistically significant difference between the mean score of the overall quality of life, physical health, psychological health, social health, and environment across the low and high-noise areas ($p < 0.01$), However, this study suggests that people living in low-noise areas have a better quality of life and health in the four domains WHO HRQOL than those in high-noise areas.

Discussion

The study found that respondents living in high-noise areas exhibited greater noise sensitivity compared to those in low-noise areas, indicating that proximity to traffic noise influences noise sensitivity profiles. This aligns with previous research demonstrating variability in noise sensitivity among populations.[14,15] Additionally, noise sensitivity was negatively associated with self-reported WHOQOL scores across the entire sample, suggesting that individuals with higher noise sensitivity tend to report lower quality of life. Notably, in low-noise areas, this negative association was significant in the physical and social domains, whereas in high-noise areas, it extended across all four WHOQOL domains. These findings indicate that noise sensitivity has a more pronounced impact on quality of life for those living closer to traffic noise. Similar results have been reported in studies examining noise reactions in various settings, including community, transportation, industrial, and aircraft noise.[16]

The findings from this study demonstrate that individuals residing in low-noise areas report a better quality of life (QOL) and health status across all four domains of the WHO Health-Related Quality of Life (HRQOL) assessment: physical, psychological, social, and environmental. In contrast, those living in high-noise areas experience lower scores in these domains. This observation aligns with a wider body of research indicating that exposure to road traffic noise is associated with diminished HRQOL.[17,18]

Previous studies have consistently linked noise exposure to a general decline in HRQOL.[19,20] For example, research conducted by Tinnam in 2021 found that individuals living in close proximity to busy traffic routes experienced disruptions to mental work and sleep due to noise[20] Similarly, Shepherd (2010) reported that residents living near motorways had poorer health outcomes in all WHOHQOL-BREF domains.[14]

The negative impact of noise exposure on HRQOL appears to be exacerbated when combined with personality traits that increase vulnerability to noise perception. In this study, increased noise sensitivity was observed among residents in high-noise areas, which may contribute to the observed reduction in HRQOL. This suggests that individuals with higher noise sensitivity are particularly susceptible to the adverse effects of environmental noise on their well-being.

Furthermore, existing research highlights a link between reduced work productivity and lower

quality of life, indicating that environments with persistent noise pollution may not only affect health but also impact occupational performance. In support of this, Table 2 from the study shows that 82% of participants in high-noise areas reported being extremely annoyed by noise, underscoring the potential for high-noise environments to negatively influence workplace productivity.

Annoyance is one of the most striking effects of noise exposure on individuals. The noise levels measured in the high-noise area ranged between 71 and 77 dB (day-night average sound levels, Ldn) over a 24-hour period. According to the World Health Organisation (WHO) guideline, a day-night average sound level of 55 dB is considered the threshold for defining noise impact in urban residential areas.[21] Exceeding this threshold, particularly for durations over eight hours, can lead to serious annoyance among residents. In this study, the low-noise area-maintained noise levels below the minimum safety standard of 55 dB, whereas the high-noise area exceeded this standard. Notably, noise levels above 70 dB can result in hearing impairment and have been found to interfere with optimal daily functioning. As a result, residents in high-noise areas were frequently exposed to levels of environmental noise that could significantly affect their quality of life and overall health. These findings reinforce previous research suggesting that road traffic noise exposure may adversely impact health-related quality of life (HRQOL).

The study revealed that 43.2% of respondents in high-noise areas and 7.9% in low-noise areas reported experiencing extreme annoyance due to traffic noise. The prevalence of annoyance observed here is lower than that reported in a previous study conducted in the Ibadan metropolis, where 70% of respondents were annoyed by noise. Other studies have shown varying prevalence rates.[4] For example, a survey in Egypt reported a prevalence of 65.3% for being very annoyed, while a study in New Zealand comparing noisy and quiet streets found high annoyance figures of 24.9% and 4.7%, respectively. In Ibadan, the presence of many cars and heavy-duty vehicles, due to its proximity to major highways, contributes to noise pollution, making it a common environmental problem. Most residents live in apartment-type dwellings with windows facing main roads, and many reported that their housing conditions and environment negatively affected their health. The prevalence of annoyance was higher when bedroom windows were open and faced the street.

Across the entire sample, traffic-related annoyance significantly affected overall HRQOL. The findings indicated a significant negative association between health-related quality of life across all four domains and annoyance arising from traffic noise in both residential areas. Continuous exposure to such annoyance can be detrimental to health, especially when noise levels surpass the WHO-recommended safety standards.[16] Previous studies have reported that HRQOL in quiet areas is affected by traffic annoyance to a lesser extent and in a different pattern compared to noisy areas. Literature on the health effects of traffic noise highlights that, when using the WHO's definition of health, the negative impact of traffic noise annoyance on health and quality of life is substantial.[14] The present study contributes further quantitative evidence that noise annoyance can adversely affect HRQOL.[17]

Noise sensitivity is recognised as an independent, non-acoustical factor that predicts annoyance. Individuals who are noise-sensitive tend to pay more attention to sound, evaluate it negatively, and may find it threatening or annoying.[15] Additionally, these individuals often have stronger emotional reactions to noise and greater difficulty habituating to it. Noise sensitivity has a significant effect on noise annoyance ratings, and there is a positive association between noise sensitivity and noise annoyance.[22] This finding is consistent with previous research, which indicates that noise-sensitive individuals are more susceptible to noise-induced annoyance.[23]

Study Limitations

This study has several limitations. Due to its cross-sectional design, causal inferences cannot be made regarding the relationships between noise exposure, annoyance, and health-related quality of life. Other factors not accounted for may influence these associations. Additionally, socioeconomic matching of the selected areas was not possible because of the lack of data on socioeconomic status in Ibadan, Oyo State. The study areas were purposively selected and were similar in socioeconomic status, but generalisations to other populations are limited since the research was conducted in Ibadan, Nigeria.

Conclusion

The study demonstrates that individuals living farther from traffic noise experience better health

outcomes than those residing in noisy areas. Annoyance caused by road traffic noise was more prevalent in high-noise areas, where residents were found to be more noise-sensitive and reported significantly lower health-related quality of life across physical, psychological, social, and environmental domains. The proportion of residents reporting extreme annoyance in high-noise areas was five times greater than in low-noise areas. Negative associations between noise sensitivity, traffic annoyance, and quality of life were observed in both areas, with more pronounced effects in high-noise zones. These findings support existing evidence that noise exposure is detrimental to individuals and is a major factor contributing to reduced quality of life in urban areas.

It is recommended that various designs and shapes of noise barriers be constructed to mitigate traffic noise levels. Improvements in traffic management and proper control of commercial buses and other vehicles should also be implemented. Further studies on multi-layered building designs that meet required setbacks and noise compliance standards are advised. These measures should inform traffic noise abatement policies to ensure quieter and healthier urban environments both day and night.

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