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THE ASSOCIATION BETWEEN NOISE AND FATIGUE AMONG RAILWAY WORKERS IN NIGERIA: A CASE STUDY OF WARRI-ITAKPE TRAIN SERVICE DISTRICT, NIGERIA

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ABSTRACT

Occupational fatigue is a critical, yet significantly under-researched, public health concern in the Nigerian railway industry. Railway workers are routinely exposed to hazardous noise levels, demanding psychosocial environments, and various physical stressors that cumulatively predispose them to chronic occupational fatigue. Noise, a pervasive environmental hazard in railway operations, has been recognised globally as a key contributor to worker fatigue, reduced vigilance, cognitive impairment, and diminished occupational safety. Despite rising investments in Nigeria's rail infrastructure, particularly the Warri-Itakpe Train Service (WITS), little empirical attention has been directed toward understanding the relationship between occupational noise exposure and fatigue among Nigerian railway workers. This study examined the association between noise exposure and occupational fatigue among railway workers within the Warri-Itakpe Train Service (WITS) of the Nigerian Railway Corporation (NRC). A cross-sectional quantitative research design was adopted. A total of 305 railway workers across 12 train

stations were recruited using Slovin's formula and multi-stage sampling. Data were collected using the Smith Wellbeing Survey (SWELL), a validated 27-item questionnaire. Noise levels were measured in nine sample locations aboard diesel-powered trains during 72 days of round trips. Statistical analyses included weighted averages, relative risk (RR), absolute risk (AR), Pearson's correlation, Chi-square tests, and logistic regression. The Demands, Resources, and Individual Effects (DRIVE) model guided the conceptual framework. Noise levels at all nine sample locations aboard the train ranged from 90.46 dB to 102.15 dB, significantly exceeding WHO guidelines (54 dB) and Nigeria's NESREA regulatory limit of 70 dB. Seventy-two percent (72%) of workers reported high exposure to noise and vibration, with a relative risk (RR) of 2.60 and an absolute risk (AR) of 72%, both indicating high risk for occupational fatigue. Train drivers recorded the highest noise-related exposure risk (RR = 18.50; AR = 95%). Pearson's correlation revealed a strong positive association between noise/vibration exposure and occupational fatigue ($r = 0.81$, $p < 0.01$). Noise exposure constitutes a major physical health risk for occupational fatigue among railway workers in Nigeria. The exceedance of regulatory noise thresholds across all sampling points, combined with strong statistical associations between noise and fatigue, underscores the urgency of engineering controls, personal protective equipment provision, regular maintenance of locomotives, and institutional policy reforms within the Nigerian Railway Corporation. Addressing occupational fatigue is fundamental to improving worker well-being, productivity, and the overall safety of railway transportation in Nigeria.

KEYWORDS: Noise exposure, occupational fatigue, railway workers, Warri-Itakpe Train Service, Nigerian Railway Corporation, health risk assessment, physical risk factors, psychosocial risk factors, DRIVE model, workplace safety.

1.0 INTRODUCTION

Occupational fatigue has emerged as one of the most pervasive and consequential health challenges facing workers in safety-critical industries worldwide, and the railway sector is no exception. Occupational fatigue was defined as perceived weariness arising from prolonged working, heavy workload, insufficient rest, and inadequate sleep, occupational fatigue not only degrades worker performance but also jeopardises the safety of passengers, infrastructure, and the broader transportation system (Cameron, 1973; Harma et al., 1998; Chau *et al.*, 2008). Among the many environmental stressors implicated in the development

of occupational fatigue, noise has received significant attention from researchers in transport and occupational health disciplines (Lal & Craig, 2001; Smith *et al.*, 2004).

Noise in railway environments is ubiquitous, arising from locomotive engines, wheels on tracks, ventilation systems, and power-generating sets. Prolonged exposure to elevated noise levels has been associated not only with hearing loss but also with heightened measures of fatigue, decreased vigilance, impaired decision-making, increased error rates, and reduced overall productivity (Landstrom, 1990; Melamed & Bruhis, 1996; Hamidi *et al.*, 2014). In the context of the Nigerian railway system, which has undergone substantial rehabilitation and expansion in recent years, these concerns take on particular significance. The Nigerian Railway Corporation (NRC) operates a workforce that spans multiple job types, each with its own distinct exposure profile to occupational noise and associated fatigue risks.The Warri-Itakpe Train Service (WITS), inaugurated in September 2020, represents one of Nigeria's flagship rail rehabilitation projects, connecting the port city of Warri to the inland town of Itakpe across a 326-kilometre standard gauge line covering three states: Delta, Edo, and Kogi. It operates on a daily basis. The WITS employs approximately 1,800 personnel across 12 stations. The unique operational demands of this route including shift work, long working hours, irregular schedules, and exposure to high noise levels from diesel-powered trains create a constellation of risk factors that predispose workers to occupational fatigue.

Despite growing awareness of railway worker health globally, empirical research into the specific association between noise and fatigue in the Nigerian railway context remains remarkably sparse. Studies from the Rail Safety and Standards Board (2021) demonstrated that approximately 43% of rail employees experience mental health conditions, with fatigue being a central underlying factor. The complex interplay between noise exposure and fatigue, mediated by individual characteristics, psychosocial stressors, and physical working conditions, demands rigorous empirical investigation. This study addresses that gap by systematically examining the association between noise exposure and occupational fatigue among railway workers in the WITS district, using validated instruments, objective noise measurements, and robust statistical methods. The study assessed the health risk impacts of noise exposure on railway workers and their consequences for productivity and rail transportation safety in Nigeria. Specific objectives included determining the causes of occupational fatigue, evaluating associated health risk factors, assessing the relationship

between noise exposure and fatigue, and examining the effects of health risks on worker productivity and railway safety.

2.0 MATERIALS AND METHODS

2.1 Study Area

The study was conducted within the Warri-Itakpe Train Service (WITS) District of the Nigerian Railway Corporation, headquartered in Agbor, Delta State. The WITS is a standard gauge (4 ft 8.5 in) railway connecting Warri to Itakpe across 326 km, traversing Delta, Edo, and Kogi States through 12 stations: Ujevwu, Agbarho, Okpara, Abraka, Agbor, Igbanke, Ekehen, Uromi, Agenebode, Itogbo, Ajaokuta, and Itakpe. Officially inaugurated in September 2020, the line operates passenger and freight services and employs approximately 1,800 personnel.

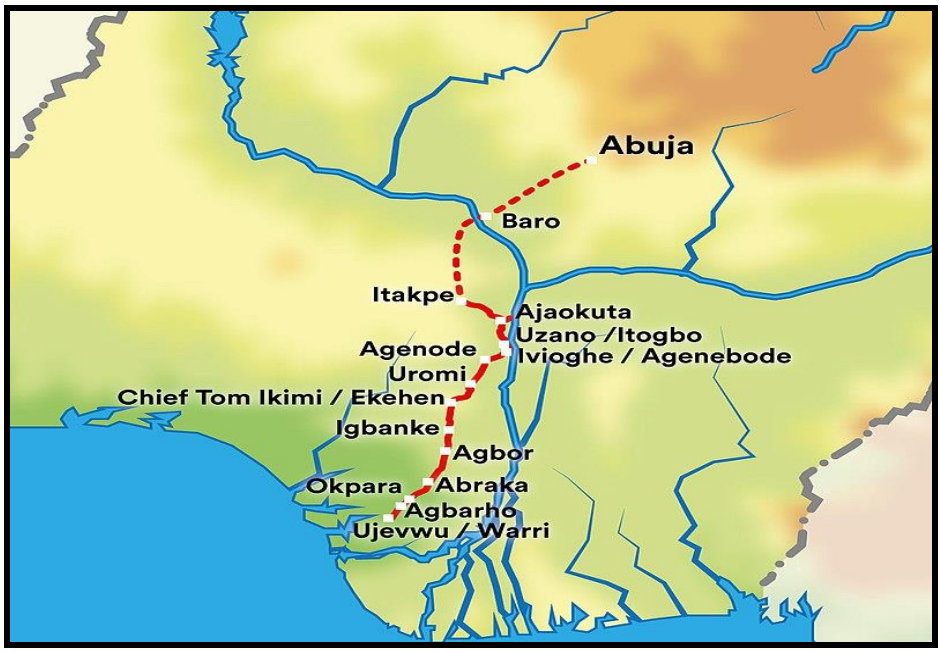

Figure 1 : Location of the Study Area in Nigeria.

2.2 Research Design and Population

A quantitative, cross-sectional survey design was adopted. The target population comprised all railway employees posted to the 12 WITS stations (N = 1,284). Sample size was determined using Slovin's formula at a 5% margin of error, yielding a sample of 305 participants. A multi-stage sampling approach was employed: stratified sampling was used to select the study locations, while purposive and random sampling techniques were applied to recruit participants with diverse job roles, including train drivers, engineers, station managers, station workers, train guards, signallers, and ticket checkers.

2.3 Data Collection Instruments

Primary data were collected using the Smith Wellbeing Survey (SWELL), a validated 27-item questionnaire adapted from the Wellbeing Process Questionnaire (WPQ; Williams, 2014). The instrument was structured into four parts covering:

(i) Personal and individual characteristics, including personality and healthy lifestyle;

(ii) Job demands, control, support, and working environment exposures;

(iii) Well-being outcomes linked to fatigue, such as job satisfaction, work stress, presenteeism, and work-life balance; and

(iv) Consequences of fatigue including absenteeism and workplace accidents.

Responses were measured on a 10-point Likert scale (1 = not at all; 10 = very much so), with some items requiring Yes/No responses. Prior informed consent was obtained from all participants, and confidentiality was ensured through anonymisation. In addition to the survey, objective noise levels were measured in nine (9) sample locations aboard diesel-powered trains (2 locomotives, 6 passenger coaches, and 1 power car). Measurements were taken during 72 days of fixed round trips (Ujevwu–Itakpe and Itakpe–Ujevwu) in the morning (08:00–10:00) and evening (16:00–18:00), yielding multiple observations per location.

2.4 Theoretical Framework

The study was guided by the Demands, Resources, and Individual Effects (DRIVE) Model (Mark & Smith, 2008), which conceptualises occupational fatigue as a function of job demands (workload, noise, vibration, fumes), job resources (support and control), and individual differences (personality, coping strategies, health behaviours). The DRIVE model was augmented with personality measures to account for the role of individual characteristics in moderating fatigue outcomes.

2.5 Ethical Considerations

Ethical approval was granted by the College of Science Research Ethics Committee at the Federal University of Petroleum Resources, Effurun. All participants were fully briefed on the purpose of the study before enrolment. Participation was entirely voluntary, and participants were free to withdraw at any time without consequence. Anonymity was maintained throughout.

2.6 Data Analysis

Data were analysed using SPSS Version 25.0. Weighted averages were calculated to determine risk levels (low/high) for each health risk factor. Relative Risk (RR) and Absolute Risk (AR) were computed to quantify the strength and likelihood of association between health risk factors and occupational fatigue. Pearson's correlation examined the magnitude and direction of associations, while Chi-square tests assessed statistical significance of associations. Logistic regression analysis identified the predictive capacity of each health risk factor for occupational fatigue. Noise data were compared against WHO and NESREA regulatory benchmarks.

3.0 RESULTS AND DISCUSSION

3.1 Sociodemographic Characteristics

Table 1 shows the sociodemographic characteristics of the 305 respondents. The table shows that 223 (73%) were male and 82 (27%) were female, reflecting the male-dominated nature of railway operations in Nigeria. The majority (57%) were aged 18–30 years, representing a predominantly youthful workforce, partly attributable to the 2023 recruitment exercise. In terms of educational attainment, 48% held bachelor's degrees or higher, 34% held diplomas, and 18% possessed senior secondary leaving certificates, attesting to the technical character of the workforce. In terms of job designation, station workers constituted the largest group (26%), followed by engineers (25%), station managers (16%), train drivers (13%), train guards (9%), signallers (7%), and ticket checkers (6%).

Table 1: Sociodemographic Characteristics of Respondents.

S/N	Sociodemographic Characteristics	Classes	Number	Percentage	Remarks
1	Sex Distribution	Male	223	73	Male dominated
		Female	82	27	
2	Age Distribution	18 - 30	174	57	Youthful workforce
		30 - 60	131	43	
3	Educational Attainment	Higher/Bachelor degrees	146	48	Higher Technical Staff
		Diploma	104	34	
		Secondary	55	18	
4	Job Description	Station Workers	79	26	More station workers
		Engineers	76	25	
		Station Managers	49	16	
		Train Drivers	40	13	
		Train Guards	27	9	
		Signallers	21	7	
		Ticket Checkers	18	6	

Source: Authors' Laboratory Analysis, 2025

3.2 Noise Level Measurements

Objective noise measurements across the nine sample locations revealed that noise levels ranged from a mean of 90.46 dB (Coach 6) to 102.15 dB (Power Car), as presented in Table 2. All measured values significantly exceeded both the WHO regulatory limit of 54 dB and Nigeria's NESREA standard of 70 dB for workplace environments. The locomotives (Loco 1: 101.56 dB; Loco 2: 101.96 dB) and the power car (102.15 dB) recorded the highest noise levels, consistent with the positioning of diesel engines and power-generating sets in these compartments. Even the passenger coaches, which represent a relatively more sheltered environment, recorded noise levels well above regulatory thresholds, ranging from 90.46 dB to 92.19 dB.

Table 2: Mean Noise Level Measurements Across Sample Locations Aboard the WITS Train.

Location	Loco 1 (N1)	Coach 1 (N2)	Coach 2 (N3)	Coach 3 (N4)	Coach 4 (N5)	Coach 5 (N6)	Coach 6 (N7)	Power Car (N8)	Loco 2 (N9)
Mean (dB)	101.56	90.56	91.21	91.67	92.19	91.50	90.46	102.15	101.96
WHO Limit: 54 dB | NESREA Limit: 70 dB. All locations exceed regulatory thresholds.									

Source: Authors' Laboratory Analysis, 2025

These findings are consistent with earlier studies implicating railway noise as a major occupational stressor (Lal & Craig, 2001; Eyimaya & Tezel, 2021). The persistently elevated noise levels, attributable largely to poor maintenance of locomotives, rolling stock, and power-generating sets, create conditions highly conducive to the development of occupational fatigue through mechanisms including sleep disruption, sustained stress responses, and cognitive overload.

3.3 Association Between Noise and Occupational Fatigue

Survey data revealed that 72% of all respondents reported high exposure to noise and vibration (RR = 2.60; AR = 72%), categorising noise and vibration as the most prominent physical health risk factor for occupational fatigue across the entire workforce. This association was substantiated statistically by Pearson's correlation analysis, which demonstrated a strong positive association between noise/vibration exposure and occupational fatigue ($r = 0.81$, $p < 0.01$), the highest correlation coefficient recorded among all physical risk factors. Logistic regression further indicated that noise and vibration

exposure accounted for 44% of the variance in occupational fatigue outcomes, underscoring its predictive significance.

When disaggregated by job type, the association between noise exposure and fatigue was most pronounced among train drivers (RR = 18.50; AR = 95%), who spend extended durations in close proximity to locomotive engines. Train guards (RR = 7.00; AR = 88%), engineers (RR = 5.25; AR = 84%), and signallers (RR = 4.50; AR = 82%) also demonstrated high noise-related occupational fatigue risks. In contrast, station managers, who spend more time in enclosed administrative spaces, recorded significantly lower noise exposure risks (RR = 0.41; AR = 29%). These differences highlight the occupational gradient of noise exposure within the railway environment and the importance of targeting noise reduction interventions toward frontline operational workers as seen in Table 3.

Table 3: Noise and Vibration Relative Risk (RR) and Absolute Risk (AR) by Job Type.

Job Type	N	RR	AR (%)	Risk Decision
Train Drivers	39	18.50	95	High Risk
Train Guards	24	7.00	88	High Risk
Engineers	75	5.25	84	High Risk
Signallers	22	4.50	82	High Risk
Ticket Checkers	18	5.00	83	High Risk
Station Workers	79	1.93	66	High Risk
Station Managers	48	0.41	29	Low Risk

Source: Authors' Laboratory Analysis, 2025

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

This study provides compelling evidence that noise exposure is a critical and statistically significant risk factor for occupational fatigue among railway workers in Nigeria's Warri-Itakpe Train Service. Noise levels at all nine measured locations exceeded WHO and NESREA regulatory benchmarks by substantial margins, with mean levels ranging from 90.46 dB to 102.15 dB nearly double the WHO guideline of 54 dB. Seventy-two percent of workers across the workforce reported high noise and vibration exposure, and train drivers faced a relative risk of 18.50 for noise-related fatigue the highest of any job type. Pearson's correlation ($r = 0.81$) and logistic regression ($R^2 = 0.44$) confirmed the strong predictive relationship between noise exposure and fatigue.

4.2 Recommendations

Based on the study findings, the following recommendations are proposed:

i. The management of NRC should implement engineering controls to reduce noise at source, including regular and preventive maintenance of locomotives, rolling stock, and power-generating sets. Soundproofing of cabs and crew compartments should be prioritised, alongside real-time noise monitoring systems.

ii. All workers exposed to noise levels exceeding 70 dB must be provided with appropriate hearing protection (earplugs or earmuffs), alongside training on their correct and consistent use.

iii. The NRC management should develop and implement a comprehensive fatigue risk management policy, including scheduling regular breaks, enforcing maximum shift hours, and providing adequate rest periods particularly for train drivers and engineers.

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