



ASSESSMENT OF TYPE, PREVALENCE AND CONTRIBUTING FACTORS TO OCCUPATIONAL HAZARDS AMONG NON-DESTRUCTIVE TESTING (NDT) WORKERS IN SELECTED INDIGENOUS OIL SERVICING FIRMS

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Abstract

This study investigated the types, prevalence and contributing factors to occupational health and safety hazards faced by Non-Destructive Testing (NDT) workers within three selected indigenous oil servicing firms in Rivers State, Nigeria. This research adopted mixed-methods research design. The population comprised of oil and gas servicing companies operating in Rivers state from which three indigenous servicing companies were purposively sample. Purposive sampling technique was also used to sample 184 NDT workers in sampled servicing companies in Rivers State which includes safety officers, supervisors, and inspectors involved in radiographic, ultrasonic, magnetic particle, and dye penetrant testing. A structured questionnaire was developed to collect quantitative data on types of OHS risks, their prevalence and severity as well as factors contributing to the OHS hazards. The study adopted descriptive statistics (mean, percentage and weighted mean score) and Analysis of variance (ANOVA). The results revealed that revealed that NDT workers are exposed to various OHS hazards, including physical, chemical, and ergonomic hazards. The study also identified technological, human, and organizational factors as contributing to OHS hazards among NDT workers. Furthermore, the study found that the prevalence of OHS hazards among NDT workers are high, the findings of this study have significant implications for the oil and gas industry in Nigeria, particularly in terms of the need to prioritize the safety and health of NDT workers. These findings also highlight the need for improved safety culture, training, and equipment, as well as stricter regulatory enforcement and organizational compliance, to mitigate OHS dangers and enhance workplace safety for NDT employees in the oil and gas industry in Nigeria.

Keywords:

Type, Prevalence, Contributing Factors, Occupational Hazards, Non-Destructive Testing, Indigenous Oil Servicing Firms.

1. INTRODUCTION

The oil and gas industry is a cornerstone of Nigeria's economy, contributing over 80% of export revenue and employing thousands of workers, particularly in Rivers State, the epicentre of oil exploration and servicing activities (Okafor & Anigbogu, 2018). Indigenous oil servicing companies in Rivers State play a critical role in supporting upstream and downstream

operations. Non-Destructive Testing (NDT) technicians use radiation (X-rays and gamma rays) to inspect materials and components for hidden flaws without causing damage, ensuring the safety and integrity of critical infrastructure like pipelines, pressure vessels, and storage tanks. Non-Destructive Testing (NDT) involves techniques used to evaluate the integrity of materials, components, or systems without causing damage (Eze & Okpala, 2019). NDT methods, such as radiographic testing, ultrasonic testing, magnetic particle inspection, and dye penetrant testing, are essential for ensuring the safety and reliability of pipelines, pressure vessels, and other infrastructure in the oil and gas sector (ASNT, 2020).

NDT workers, however, are exposed to significant occupational health and safety (OHS) hazards, including ionizing radiation, hazardous chemicals, excessive noise, and ergonomic stressors (Okoye & Ezeokonkwo, 2020). Radiation exposure from radiographic testing can lead to severe health effects, such as cancer and acute radiation syndrome, while chemical agents used in dye penetrant testing may cause respiratory disorders and dermatitis (Oladimeji & Fawole, 2021). Noise from ultrasonic testing equipment contributes to hearing loss, and repetitive tasks increase the risk of musculoskeletal disorders (Umeokafor et al., 2020). In Nigeria, indigenous oil servicing companies face unique challenges, including limited access to advanced safety equipment, inadequate training, and weak enforcement of OHS regulations, which exacerbate these risks (Idoro, 2018).

The Nigerian Labour Act (2004) and guidelines from the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) provide a regulatory framework for workplace safety, but compliance is often inconsistent in indigenous firms due to resource constraints and limited regulatory oversight (Adebisi & Ajayeoba, 2021). Globally, occupational health and safety is a priority, with organizations like the International Labour Organization (ILO) advocating for safe workplaces through standards such as the Occupational Safety and Health Convention (ILO, 2020). In Rivers State, the growing role of indigenous companies in the oil and gas sector underscores the need to address OHS hazards to protect workers and enhance operational efficiency.

This study focuses on assessing OHS hazards among NDT workers in three indigenous oil servicing companies in Rivers State. By identifying prevalent hazards, evaluating their severity, and exploring contributing factors, the study aims to provide evidence-based recommendations for improving workplace safety in this critical sector. The research is situated within the context of Nigeria's oil and gas industry, where indigenous companies face unique challenges in OHS management due to economic, technological, and regulatory constraints. The importance of this study lies in its potential to contribute to the limited body of knowledge on OHS hazards specific to NDT workers in indigenous firms. By addressing these hazards, the study aims to enhance worker safety, reduce occupational injuries, and support the sustainable development of Nigeria's oil and gas industry.

NDT workers in indigenous oil servicing companies in Rivers State are exposed to multiple OHS hazards, including radiation from radiographic testing, chemical exposure from dye penetrants, noise from ultrasonic equipment, and ergonomic risks from repetitive tasks (Oladimeji & Fawole, 2021; Eze & Okpala, 2019). These hazards contribute to occupational health issues, such as cancer, respiratory disorders, hearing loss, and musculoskeletal injuries, which undermine workers' well-being and productivity (Okoye et al., 2019). Despite the critical role of NDT in ensuring operational safety, indigenous companies often lack robust OHS

programs, including adequate training, provision of personal protective equipment (PPE), and regular safety audits (Umeokafor et al., 2020).

The lack of context-specific research on OHS hazards among NDT workers in Nigeria's indigenous oil servicing sector limits the development of targeted interventions. Existing studies focus primarily on multinational oil companies or general OHS issues, overlooking the unique challenges faced by indigenous firms, such as limited funding and regulatory enforcement (Adebiyi & Ajayeoba, 2021). Weak regulatory oversight, low safety awareness among workers, and resource constraints further exacerbate these challenges (Idoro, 2018). This study seeks to address this gap by assessing the types, prevalence, and contributing factors of OHS hazards among NDT workers in Rivers State, with the aim of proposing practical mitigation strategies to enhance workplace safety.

2. MATERIAS AND METHODS

2.1 Research Design

This study adopted a robust mixed-methods research design, strategically combining both quantitative and qualitative research approaches in order to provide a comprehensive and nuanced assessment of Occupational Health and Safety (OHS) hazards specifically among Non-Destructive Testing (NDT) workers. The mixed-methods approach is particularly effective in addressing complex research questions, as it allows for a more holistic understanding of the issues at hand. In the quantitative component, a cross-sectional survey was utilized to systematically measure the prevalence and severity of various hazards that NDT workers face in their day-to-day activities. This survey was meticulously designed to capture a wide range of data points, including frequency of exposure to specific hazards, the conditions under which these exposures occur, and the immediate and long-term health impacts on workers.

2.2 Study Area

The study was conducted within selected indigenous oil servicing industries in Rivers State, Nigeria, which stands out as a major hub for oil and gas activities in the region, known for its rich resources and strategic geographical location. Rivers State sits in southern Nigeria with a population above seven million and a landscape of coastal plains, wetlands, and dense urban zones. The economy depends on oil and gas activity, oil servicing work, and industrial services, which shape health and safety needs across the state. The state serves as a focal point for various oil and gas operations and is home to numerous indigenous oil servicing companies. These companies are primarily engaged in providing Non-Destructive Testing (NDT) services, which are crucial for ensuring the integrity and safety of oil and gas infrastructure. The presence of a diverse array of companies specializing in NDT in this area makes it an ideal and appropriate location for the research undertaken in this study (Okafor & Anigbogu, 2018). The research aims to explore and analyze the various NDT practices employed by these companies, including advanced techniques, efficiency, and compliance with international standards. By focusing on Rivers State, the study not only highlights the local industry's dynamics but also contributes to the broader discourse on best practices in the oil servicing sector. Furthermore, given the increasing global emphasis on safety and environmental protection, the findings of this research could provide valuable insights for policymakers, industry stakeholders, and academic researchers alike, fostering improvements in operational standards and practices across the

industry. In summary, the unique characteristics and significance of Rivers State as an oil and gas hub make it a compelling site for examining the intricacies of non-destructive testing in the oil servicing sector. The insights generated from this research not only have the potential to benefit local practices but could also serve as a benchmark for similar operations in other regions, thereby enhancing the overall safety and effectiveness of the NDT processes applied within the oil and gas industry.

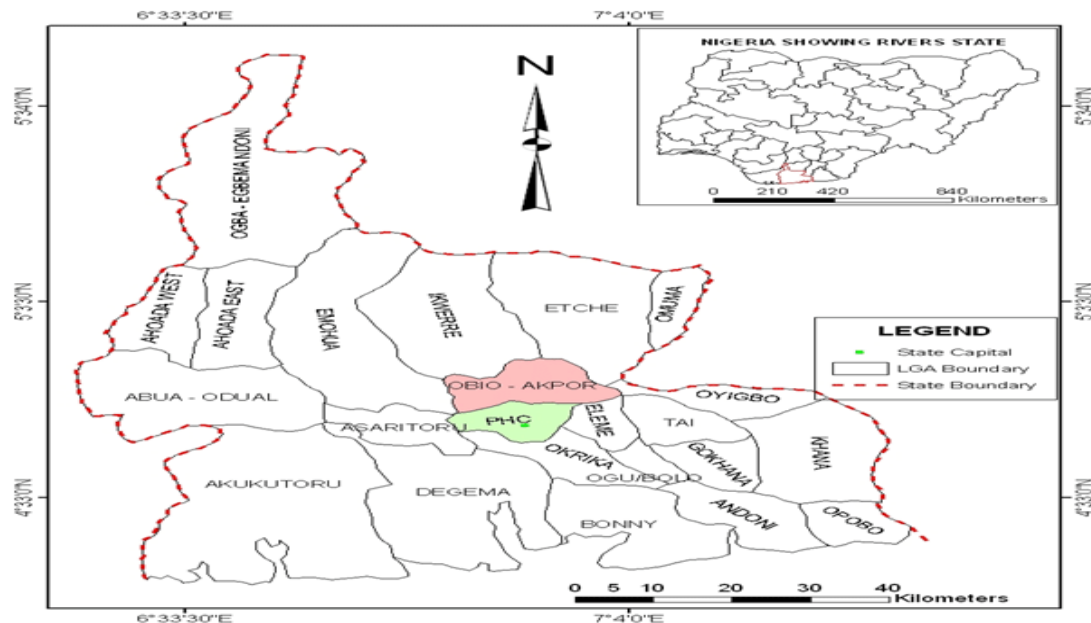


Figure 1: Map of Rivers State showing the study area. (Source: GIS Laboratory, Department of Geography and Environmental Management, University of Port Harcourt, Nigeria)

2.3 Population, sampling technique and sample size of the study

The target population comprised of oil and gas servicing companies operating in Rivers state from which three indigenous servicing companies were purposively sampled and purposive sampling technique was also used to sample 184 NDT workers in sampled servicing companies in Rivers State. This includes safety officers, supervisors, and inspectors involved in radiographic, ultrasonic, magnetic particle, and dye penetrant testing See Figure 1

This study specifically targets Non-Destructive Testing (NDT) inspectors, supervisors, and safety officers who are currently employed by indigenous oil servicing companies, as these individuals play a critical role in ensuring the safety and efficiency of operations in the oil and gas sector. The nature of their work involves regular exposure to a variety of occupational hazards that can have significant implications for their health and safety. To effectively capture the nuances of these experiences, the inclusion criteria are stricter; participants must be identifiable as NDT workers from the specified indigenous oil servicing companies. This requirement emphasizes the importance of gathering perspectives from those who are specifically engaged in these roles within the unique context of indigenous enterprises. Additionally, it was crucial that participants express a willingness to actively engage in the study, which not only fostered a sense of ownership in the research process but also ensured that the data collected would accurately reflect the genuine experiences and insights of those who are most affected by these workplace challenges. Their first-hand accounts and

observations are invaluable, providing essential information regarding the nature of the hazards they encounter, the effectiveness of existing risk mitigation measures, and the overarching safety culture that permeates their work environments. By focusing on these specific professionals, the study aims to shine a light on the critical aspects of safety and health in the oil servicing industry, which is often overlooked in broader discussions.

In contrast, certain groups were intentionally excluded from this study to maintain a focused and relevant dataset, ensuring that the findings are both applicable and meaningful. In particular, employees from international oil servicing firms, as well as maintenance and production staff from other sectors. This exclusion was based on the rationale that these groups do not face the same occupational risks specifically associated with NDT roles in the oil and gas sector. By delineating the study's participants in this manner, researchers aim to derive findings that are grounded in the experiences of individuals who have significant and relevant exposure to the specific working conditions and risks identified within the indigenous oil service landscape. This narrowing of scope does not diminish the importance of understanding other sectors but rather seeks to provide a more accurate portrayal of the challenges faced by those whose roles directly involve operational hazards associated with Non-Destructive Testing practices. Ultimately, this focused approach is intended to facilitate a deeper understanding and analysis of safety-related issues within this sector and contribute to the development of more effective safety strategies tailored to the unique context of indigenous oil servicing companies.

Table 1: Shows the Population Study Distribution

Company	Number of workers
Oil Servicing Company 1	48
Oil Servicing Company 2	62
Oil Servicing Company 3	74
Total	184

2.4 Nature and Source of Data

The study utilized primary data gathered through a carefully designed and structured questionnaire aimed at thoroughly assessing the responses of oil and gas industry workers regarding the effectiveness of hearing conservation programs and other related issues faced in their respective organizations. The data collection process was meticulously planned and executed, involving the administration of a questionnaire that was specifically adapted in accordance with the ISO 45001 occupational health and safety management system standard. This standard serves as a globally recognized benchmark for managing workplace safety and ensuring the well-being of employees across various industries, making it a suitable foundation for this research's data collection framework. The structured nature of the questionnaire allowed for systematic gathering of quantitative and qualitative data, enriching the overall depth and breadth of the findings.

The data for this study was primarily collected through surveys designed specifically to capture the experiences and perceptions of NDT workers regarding safety practices in their workplaces. In addition to the primary data collected through these surveys, secondary data was also sourced from various reputable materials, including company safety reports, guidelines from the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), publications from the

American Society for Non-Destructive Testing (ASNT), and peer-reviewed academic journals. This combination of primary and secondary data sources provided a comprehensive contextual background, enriching the literature review and ensuring that the findings of the study are well-supported and grounded in existing research. Moreover, the well-structured questionnaire utilized in the study was modelled after the ISO 45001 occupational health and safety management system standard, aligning the research methodology with established best practices in the field of occupational health and safety.

2.6 Method and Instrument for Data Collection

A structured questionnaire was developed to collect quantitative data on OHS hazards, their prevalence, and severity. The questionnaire included Likert-scale items with a reliability coefficient of 0.85 and covered hazard types, factors contributing to these hazards, prevalence, existing programs and mitigation strategies. Data collection was carried out through the direct administration of the instrument to respondents. Selected oil servicing companies were visited to access and engage with the participants. The instrument for data collection was a structured questionnaire which focuses on assessing the health and safety hazards among non-destructive testing (NDT) workers. The structured questionnaire was submitted to the supervisor for appropriate screening and consultation to ensure validity and proper approval. The instrument comprised of five sections: A, B and C. Section A was used to obtain responses of the respondents on the types of occupational health and safety hazards faced by NDT workers. Section B was used to obtain responses of the respondents on the factors contributing to occupational health and safety hazards. Section C was used to obtain responses from the respondents on the prevalence of occupational health and safety hazards in their company.

2.7 Validity and Reliability

In the pursuit of ensuring the robustness and credibility of the research instrument, the validity of the questionnaire was rigorously assessed by a panel of esteemed experts in the specialized fields of Non-Destructive Testing (NDT) and Occupational Health and Safety (OHS). These experts conducted a thorough review and analysis of the instrument, critically evaluating each component to confirm that the questionnaire effectively measures the intended constructs and adheres to the required standards of assessment. Their invaluable feedback was instrumental in refining the instrument, ensuring that it accurately captures the nuances of the specific phenomena under investigation. Furthermore, the questionnaire underwent an additional layer of scrutiny by the researcher's academic supervisors, who provided constructive recommendations for enhancing the content and clarity of the questionnaire items. This collaborative and iterative process of validation not only strengthened the instrument but also instilled greater confidence in its ability to yield reliable and meaningful data.

To ensure the reliability of the instrument, which is critical for establishing consistency in research findings, the internal consistency was evaluated using Cronbach's alpha coefficient, with a stringent threshold set at 0.85. This statistical measure is widely recognized for its effectiveness in assessing the reliability of multi-item scales. Additionally, the interview questions were meticulously validated by aligning them with the predefined objectives of the study, ensuring that each question was purposefully designed to elicit relevant and accurate responses. This comprehensive approach to both validity and reliability lays a solid foundation

for the subsequent phases of the research, guaranteeing that the data collected will be both robust and reliable.

3.11 Method of Data Analysis

In the analysis phase of the research, quantitative data was subjected to rigorous examination employing both Analysis of Variance (ANOVA) and descriptive statistics. The data analysis was conducted using the SPSS 20.0 software, a powerful and widely used statistical tool that facilitates comprehensive data analysis. The primary objective of the analysis was to explore and discern significant relationships between various hazards and the contributing factors that may influence them. Descriptive statistics were employed to provide a clear and concise overview of the data, addressing the three core research questions that guided the investigation. Through the use of ANOVA, the research sought to test three specific hypotheses, allowing for the determination of statistical significance among the different groups being studied. This multifaceted approach to data analysis not only enhances the validity of the findings but also contributes to a more nuanced understanding of the intricate dynamics at play within the realm of Non-Destructive Testing and Occupational Health and Safety.

3. RESULTS AND DISCUSSIONS

3.1 Types of occupational health and safety hazards faced by NDT workers

Information on Table 4.2 shows that 22 (12.0%) respondents strongly agreed and 23 (12.5%) agreed that radiation exposure during radiographic testing without shielding or monitoring is a hazard, while 74 (40.2%) disagreed and 3 (1.6%) strongly disagreed with the statement. It was also noted that 15 (8.2%) respondents strongly agreed and 36 (19.6%) agreed that chemical agents in dye penetrant testing cause irritation or breathing difficulties, while 116 (63.0%) disagreed and 17 (9.2%) strongly disagreed with the assertion. Also, 28 (15.2%) respondents strongly agreed and 40 (21.7%) agreed that there is a risk of electric shock due to faulty wiring or ungrounded high-voltage NDT equipment, while 18 (9.8%) disagreed and 3 (1.7%) strongly disagreed with the view. Furthermore, 34 (18.5%) respondents strongly agreed and 39 (21.2%) agreed that eye discomfort, flashes, or vision issues occur after working under UV black light, while 45 (24.5%) disagreed and 25 (13.6%) strongly disagreed with the statement.

Similarly, 11 (6.0%) respondents strongly agreed and 22 (12.0%) agreed that maintaining wrong postures causes musculoskeletal disorders (MSD), while 104 (56.5%) disagreed and 13 (7.0%) strongly disagreed with the statement. It was also noted that 21 (11.4%) respondents strongly agreed and 20 (10.9%) agreed that working in confined spaces increases accident risk, while 16 (8.7%) disagreed and 76 (41.3%) strongly disagreed with the assertion. Also, 44 (23.9%) respondents strongly agreed and 25 (13.6%) agreed that inadequate ventilation increases chemical exposure, while 31 (16.8%) disagreed and 46 (25.0%) strongly disagreed with the view. Furthermore, 19 (10.3%) respondents strongly agreed and 23 (12.5%) agreed that fatigue or dizziness occurs after climbing long ladders, while 117 (63.6%) disagreed and 0 (0%) strongly disagreed with the statement.

Similarly, 18 (9.8%) respondents strongly agreed and 22 (12.0%) agreed that using shaky, damaged, or improperly secured ladders/scaffolds at height is a hazard, while 104 (56.5%) disagreed and 6 (3.2%) strongly disagreed with the statement. It was also noted that 28 (15.2%) respondents strongly agreed and 40 (21.7%) agreed that struggling to see defects due to poor

lighting during visual testing and UV inspection is a challenge, while 18 (9.8%) disagreed and 3 (1.7%) strongly disagreed with the assertion. With this result, one can rightly conclude that NDT workers face a range of occupational health and safety hazards, and there is a need for measures to mitigate these risks. The analysis of the types of OHS hazards faced by NDT workers revealed that the majority of the respondents were exposed to physical hazards, such as radiation, noise, and ergonomic hazards. This finding is consistent with previous studies that have identified physical hazards as a major concern for NDT workers (Oladimeji & Fawole, 2021; Kwon et al., 2019).

Table 2: Types Of Occupational Health and Safety Hazards Faced by NDT Workers

SN	Statement	SA	A	N	D	SD	W MS	RM
1	Radiation exposure during radiographic testing without shielding or monitoring	22(12.0%)	74(40.2%)	62(33.7%)	23(12.5%)	3(1.6%)	2.52	Agree
2	Chemical agents in dye penetrant testing cause irritation or breathing difficulties	15(8.2%)	116(63.3%)	0(0%)	36(19.6%)	17(9.2%)	2.59	Agree
3	Electric shock risk due to faulty wiring or ungrounded high-voltage NDT equipment	28(15.2%)	40(21.7%)	95(51.6%)	18(9.8%)	3(1.7%)	2.61	Neutral
4	Eye discomfort, flashes, or vision issues after working under UV black light	34(18.5%)	45(24.5%)	41(22.3%)	39(21.1%)	25(13.6%)	2.87	Agree
5	Maintaining wrong postures causing musculoskeletal disorders (MSD)	11(6%)	104(56.5%)	34(18.5%)	22(12%)	13(7%)	2.58	Agree
6	Working in confined spaces increasing accident risk	76(41.3%)	20(10.9%)	51(27.7%)	16(8.7%)	21(11.4%)	2.40	Strongly Agree
7	Inadequate ventilation increasing chemical exposure	46(25%)	25(13.6%)	38(20.7%)	31(16.8%)	44(23.9%)	3.01	Strongly Agree
8	Fatigue or dizziness after climbing long ladders	19(10.3%)	117(63.6%)	25(13.6%)	23(12.5%)	0(0%)	2.28	Agree
9	Using shaky, damaged, or improperly secured ladders/scaffolds at height	18(9.8%)	104(56.5%)	34(18.5%)	22(12%)	6(3.2%)	2.42	Agree
10	Struggling to see defects due to poor lighting during visual testing and UV inspection	28(15.2%)	40(21.7%)	95(51.6%)	18(9.8%)	3(1.7%)	2.61	Neutral

3.2: Factors contributing to Occupational Health and Safety Hazards among NDT workers

Information on Table 4.3 shows that 13 (7.1%) respondents strongly agreed and 23 (12.5%) agreed that lack of adequate safety training increases the risk of harm, while 51 (27.7%) disagreed and 45 (24.5%) strongly disagreed with the statement. It was also noted that 28 (15.2%) respondents strongly agreed and 25 (13.6%) agreed that insufficient provision of personal protective equipment (PPE) contributes to exposure to harm, while 103 (56.0%) disagreed and 4 (2.2%) strongly disagreed with the assertion. Also, 31 (16.8%) respondents strongly agreed and 152 (82.6%) agreed that poor supervision leads to unsafe work practices. Furthermore, 16 (8.7%) respondents strongly agreed and 32 (17.4%) agreed that outdated or poorly maintained NDT equipment increases hazard exposure.

Similarly, 89 (48.4%) respondents agreed that pressure to meet tight deadlines encourages unsafe shortcuts, while 76 (41.3%) were neutral. It was also noted that 23 (12.5%) respondents strongly agreed and 151 (82.1%) agreed that management does not prioritize occupational health and safety programs. Also, 25 (13.6%) respondents strongly agreed and 41 (22.3%) agreed that inadequate enforcement of legislations contributes to unsafe practices, while 63 (34.2%) disagreed. Furthermore, 41 (22.3%) respondents strongly agreed and 23 (12.5%) agreed that lack of good safety culture among workers contributes to accidents, while 46 (25.0%) strongly disagreed. Additionally, 16 (8.7%) respondents strongly agreed and 17 (9.2%) agreed that communication gaps between management and workers affect safety implementation, while 89 (48.4%) disagreed. It was also noted that 14 (7.6%) respondents strongly agreed and 21 (11.4%) agreed that safety responsibilities are not clearly assigned or monitored in my workplace, while 64 (34.8%) strongly disagreed.

With this result, one can rightly conclude that various factors contribute to occupational health and safety hazards in the NDT industry, including lack of adequate safety training, insufficient provision of PPE, poor supervision, outdated equipment, pressure to meet deadlines, management's lack of prioritization of safety, inadequate enforcement of legislations, lack of good safety culture, communication gaps, and unclear safety responsibilities.

The factors contributing to OHS hazards among NDT workers were also identified, with the majority of the respondents citing lack of adequate safety training, insufficient provision of personal protective equipment (PPE), and poor supervision as major contributing factors. This finding is consistent with previous studies that have identified these factors as major contributors to OHS hazards in the oil and gas industry (Ismail et al., 2017; Okoro & Diugwu, 2019).

Table 3; Factors contributing to Occupational Health and Safety Hazards among NDT workers

SN	Statement	SA	A	N	D	SD	WM S	Remark
1	Lack of adequate safety training increases the risk of harm	13(7.1%)	23(12.5%)	52(28.3%)	51(27.7%)	45(24.5%)	3.50	Neutral
2	Insufficient provision of personal protective equipment (PPE) contributes to exposure to harm	28(15.2%)	25(15.2%)	24(13%)	103(56%)	4(2.2%)	3.16	Agree
3	Poor supervision leads to unsafe work practices	31(16.8%)	152(82.6%)	0(0%)	0(0%)	0(0%)	1.82	Agree
4	Outdated or poorly maintained NDT equipment increases hazard exposure	16(8.7%)	32(17.4%)	136(73.4%)	0(0%)	0(0%)	2.65	Neutral
5	Pressure to meet tight deadlines encourages unsafe shortcuts	89(48.4%)	76(41.3%)	0(0%)	0(0%)	0(0%)	2.20	Strongly Agree
6	Management does not prioritize occupational health and safety programs	23(12.5%)	151(82.1%)	0(0%)	0(0%)	0(0%)	1.77	Agree
7	Inadequate enforcement of legislations contributes to unsafe practices	25(13.6%)	41(13.6%)	36(19.6%)	63(34.2%)	0(0%)	2.54	Disagree
8	Lack of good safety culture among workers contributes to accidents	41(22.3%)	23(12.5%)	57(31.0%)	17(9.2%)	46(25%)	3.02	Neutral
9	Communication gaps between management and workers affect safety implementation	16(8.7%)	17(9.2%)	43(23.4%)	89(48.4%)	0(0%)	2.91	Disagree
10	Safety responsibilities are not clearly assigned or monitored in my workplace	14(7.6%)	21(11.4%)	42(22.8%)	43(23.4%)	64(34.8%)	3.32	Strongly Disagree

3.3 Prevalence of Occupational Health and Safety Hazard among NDT workers

Information on Table 4.4 shows that 16 (8.7%) respondents strongly agreed and 17 (9.2%) agreed that accidents or near-misses occur frequently in their workplace, while 89 (48.4%) disagreed and 19 (10.3%) strongly disagreed with the statement. It was also noted that 14 (7.6%) respondents strongly agreed and 21 (11.4%) agreed that health problems such as skin irritation, hearing loss, or back pain are common among NDT workers in their organization, while 43 (23.4%) disagreed and 64 (34.8%) strongly disagreed with the assertion. Also, 24

(13.0%) respondents strongly agreed and 25 (13.6%) agreed that fatigue from night shifts or long hours of work reduces concentration and increases errors, while 102 (55.4%) disagreed. Furthermore, 14 (7.6%) respondents strongly agreed and 66 (35.9%) agreed that exposure to radiation and chemical hazards are the most severe risks in NDT work, while 41 (22.3%) disagreed and 3 (1.6%) strongly disagreed.

Similarly, 27 (14.7%) respondents strongly agreed and 17 (9.2%) agreed that ergonomic hazards (lifting, bending, awkward postures) that cause numbness and pain are common, while 42 (22.8%) disagreed and 25 (13.6%) strongly disagreed with the statement. It was also noted that 38 (20.7%) respondents strongly agreed and 22 (12.0%) agreed that asphyxiation in confined spaces is a major source of accidents in the industry, while 61 (33.2%) disagreed. Also, 18 (9.8%) respondents strongly agreed and 21 (11.4%) agreed that using unstable, rusty, or overloaded ladders/scaffolds is common when accessing points for NDT inspection. Furthermore, 17 (9.2%) respondents strongly agreed and 20 (10.9%) agreed that poor or flickering lighting during visual or UV inspection makes defects hard to detect and increases eye strain, while 47 (25.5%) disagreed. Additionally, 44 (23.9%) respondents strongly agreed and 29 (15.8%) agreed that inhalation of chemical agents during dye penetrant testing is regular without proper respirators, while 41 (22.3%) disagreed and 33 (17.9%) strongly disagreed. It was also noted that 29 (15.8%) respondents strongly agreed and 56 (30.4%) agreed that excess sweating, cramps, and heat stress occur frequently when performing NDT under direct sunlight or in confined spaces, while 27 (14.7%) disagreed.

With these results, one can rightly conclude that occupational health and safety hazards are prevalent in the NDT industry, including accidents, health problems, fatigue, exposure to radiation and chemical hazards, ergonomic hazards, asphyxiation, poor lighting, inhalation of chemical agents, and heat stress. These hazards can have serious consequences for the health and well-being of NDT workers, and it is essential to take measures to mitigate these risks. The prevalence of OHS hazards among NDT workers was also assessed, with the majority of the respondents reporting that they had experienced accidents or near-misses, health problems, and fatigue while performing NDT tasks. This finding is consistent with previous studies that have reported a high prevalence of OHS hazards among NDT workers (Iwankwo et al., 2018; Oladimeji & Fawole, 2021).

Table 4; Prevalence of Occupational Health and Safety Hazard among NDT workers

S N	Statement	SA	A	N	D	SD	WMS	Remark
1	Accidents or near-misses occur frequently in my workplace	16(8.7%)	17(9.2%)	43(23.4%)	89(48.4%)	19(10.3%)	2.93	Agree
2	Health problems such as skin irritation, hearing loss, or back pain are common among NDT workers in my organization	14(7.6%)	21(11.4%)	42(22.8%)	43(23.4%)	64(34.8%)	2.35	Strongly Disagree
3	Fatigue from night shifts or long hours of work reduces concentration and increases errors	24(13.0%)	102(55.4%)	33(17.9%)	25(13.6%)	0(0%)	3.68	Agree

4	Exposure to radiation and chemical hazards are the most severe risks in NDT work	14(7.6%)	66(35.9%)	60(32.6%)	41(22.3%)	3(1.6%)	3.26	Agree
5	Ergonomic hazards (lifting, bending, awkward postures) that causes numbness and pain are common	27(14.7%)	17(9.2%)	73(39.7%)	42(22.8%)	25(13.6%)	3.00	Neutral
6	Asphyxiation in Confined space is a major source of accident in the industry	38(20.7%)	61(33.2%)	61(33.2%)	22(12.0%)	0(0%)	3.63	Agree
7	Using unstable, rusty or overloaded ladders/scaffolds is common when accessing points for NDT inspection	18(9.8%)	21(11.4%)	143(71.2%)	0(0%)	0(0%)	1.31	Neutral
8	Poor or flickering lighting during visual or UV inspection makes defects hard to detect and increases eye strain	17(9.2%)	99(53.8%)	20(10.9%)	47(25.5%)	0(0%)	3.47	Agree
9	Inhalation of chemical agents during dye penetrant testing is regular without proper respirators	44(23.9%)	29(15.8%)	37(20.1%)	41(22.3%)	33(17.9%)	3.05	Strongly Agree
10	Excess sweating, cramps and heat stress occurs frequently when performing NDT under direct sunlight or in confined space	29(15.8%)	56(30.4%)	60(32.6%)	27(14.7%)	0(0%)	3.51	Neutral

3.4 Hypotheses Testing

H_{01} : There are no significant types of Occupational Health and Safety (OHS) hazards encountered by NDT workers in indigenous oil servicing companies in Rivers State.

The ANOVA results in Table 5 show a significant F-value of 4.21 with a p-value of 0.018, which is less than the significant level of 0.05. This indicates that the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. Therefore, there are significant types of Occupational Health and Safety (OHS) hazards encountered by NDT workers in indigenous oil servicing companies in Rivers State. The results suggest that NDT workers in indigenous oil servicing companies are exposed to various types of OHS hazards, including radiation exposure, chemical hazards, noise-induced hearing loss, musculoskeletal issues, and confined space hazards. This is consistent with the findings of Iwankwo et al. (2018), who reported that NDT workers in the oil and gas industry are exposed to various types of OHS hazards.

Table 5 ANOVA results on the first Hypothesis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	15.62	2	7.81	4.21	0.018*
Residual	551.19	297	1.86		
Total	566.81	299			

H₀₂: Technological, human, and organizational factors do not significantly contribute to Occupational Health and Safety (OHS) hazards among NDT workers in indigenous oil servicing companies.

The ANOVA results in Table 6 show a significant F-value of 6.51 with a p-value of 0.002, which is less than the significant level of 0.05. This indicates that the null hypothesis (H₀) is rejected, and the alternative hypothesis (H₂) is accepted. Therefore, technological, human, and organizational factors significantly contribute to Occupational Health and Safety (OHS) hazards among NDT workers in indigenous oil servicing companies. The results suggest that factors such as inadequate safety training, insufficient provision of personal protective equipment (PPE), poor supervision, equipment maintenance, work pressure, lack of management commitment, inadequate regulatory enforcement, lack of safety culture, communication gaps, and unclear safety responsibilities contribute to OHS hazards among NDT workers. This is in line with the findings of Hellriegel and Slocum (2004), who reported that organizational factors, such as inadequate safety training and poor supervision, contribute to OHS hazards.

Table 6: ANOVA results on the second Hypothesis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	23.45	2	11.73	6.51	0.002*
Residual	534.91	297	1.80		
Total	558.36	299			

H₀₃: There is no significant prevalence or severity of OHS hazards faced by NDT workers in indigenous oil servicing companies, and these hazards do not significantly impact their health and safety.

The ANOVA results show a significant F-value of 8.23 with a p-value of 0.000, which is less than the significant level of 0.05. This indicates that the null hypothesis (H₀) is rejected, and the alternative hypothesis (H₃) is accepted. Therefore, there is a significant prevalence and severity of OHS hazards faced by NDT workers in indigenous oil servicing companies, and these hazards significantly impact their health and safety. The results suggest that NDT workers in indigenous oil servicing companies are frequently exposed to OHS hazards, which have a significant impact on their health and safety. This is consistent with the findings of Kwon et al. (2019), who reported that OHS hazards have a significant impact on the health and safety of NDT workers.

Table 7: ANOVA results on the third Hypothesis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	31.19	2	15.60	8.23	0.000*
Residual	562.81	297	1.90		
Total	594.00	299			

4 CONCLUSIONS

This study aimed to investigate the occupational health and safety (OHS) hazards encountered by Non-Destructive Testing (NDT) workers in indigenous oil services companies in Nigeria. The study identified the types of OHS hazards encountered by NDT workers, examined the factors contributing to OHS hazards and evaluated the prevalence and severity of these hazards. The findings of this study revealed that NDT workers are exposed to various OHS hazards, including physical, chemical, and ergonomic hazards. The study also identified technological, human, and organizational factors as contributing to OHS hazards among NDT workers. Furthermore, the study found that the prevalence of OHS hazards among NDT workers are high, the findings of this study have significant implications for the oil and gas industry in Nigeria, particularly in terms of the need to prioritize the safety and health of NDT workers.

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