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IMPACT OF ERGONOMIC RISK IN ELECTRICAL INDUSTRY ON ELECTRICAL WORKERS IN NORTH CENTRAL NIGERIA.

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Abstract

"Safety first" in the electrical industry should not be limited to those rules and regulations pertaining to the operation of machines, equipment, and those general rules but also to the ergonomic risk factors that could cause risks to the workers' emotion, stress and mental fillings. This study was designed to determine the impact of ergonomic risk in electrical industry on electrical workers in North Central Nigeria. Two research questions guided the study. The study adopted survey research design. The population was 140 electrical linemen in North-Central Nigeria. The sample of 60 electrical linemen was used for the study. Simple random sampling technique was used in the selection of three states. Purposive sample was used to select 20 electrical linemen from each state. The instrument used for data collection was questionnaire which consists of 19 multiple-choice items with four options. Mean and standard deviation were used to answer the research questions. The study found among others that there are ergonomic risks faced by electrical works such as lifting of heavy loads, awkward posture, repetitive bending and stooping and other. Ergonomic risk has negative effects on electrical workers such effects are: stress, musculoskeletal disorders, chronic pain and many more. Based on the findings of this study, it was recommended among others that workshops or seminar should be organize on how to reduce ergonomic risk among electrical workers, electrical workers should be taken into consideration when setting up the industry.

Keys Words: Ergonomic, Ergonomic Risk, and electrical Industry

Introduction

"Safety first" in the electrical industry should not be limited to those rules and regulations pertaining to the operation of machines, equipment, and those general rules but also to the ergonomic risk factors that could cause risks to the workers emotion, stress and mental fillings. The safety of the workers in the electrical industry should be

one of the top considerations for every electrical industry owner if they want to attain their set goal with satisfaction. The aim, goal, and objective of an industry could be crumbled; not only that, the lives of the workers could be shortened when ergonomic risks in the industry are neglected.

Industry is a place equipped with machines, tools, materials, and other relevant equipment for the production of goods and services. These industries are grouped based on the goods produced and services provided. There are different types of industries, electrical industry inclusive. The electrical industry is one of the most hazardous and physically challenging industries for workers health and the environment. In the electrical industry, there are different types and kinds of work that involve several operations that affect the physical, mental, and emotional well-being of the workers. Such activities are pulling and pushing heavy cable or wire, installation of power transformers, installation of high and low-tension equipment, servicing, maintenance, troubleshooting, and repair of electrical machines, and other activities. It is no longer news that businesses or industries are established to make a profit in the electrical industry. No matter how effective your plans are, without appropriate consideration of the safety of workers, the aim and objectives of the industry will not be achievable. If the health and safety of workers are jeopardized, the industry will not last long.

Also, as the saying goes, prevention is better than cure. The most beneficial and money-saving situation for any industry company is when everybody (employers, employees, supervisors and inspectors, and appropriate bodies responsible for safety) in the industry work together to make sure that both human and material resources are safe in the company. Lots of organizations and workers' pay this practice lip service, but they do not really believe that safety should come before deadlines, bonuses, production, or profits (Keller, 2010). There are a lot of hazards in the electrical industry that are overlooked by both employees and employers, which can lead to morbidity and mortality and damage tools and other properties. Keller (2010) stressed further that sometimes it is the simplest of precautions that can yield the greatest results. Often, employees will be mindful of major safety practices such as energized work procedures, arc blast protection, and installing conduit in trenches, but they won't take the time to focus on repetitive movements, ear protection, ladder safety, basic first aid, working position, overtime, and many more. There is a need to study the effects of these works on electrical workers. One of the important studies is the study of ergonomics. The research on ergonomics in the electrical industry on workers has the potential to significantly improve workers health and well-being, enhance workers safety, increase productivity, improve job satisfaction, and contribute to the development of best practices.

In production systems, human workers may be at risk of developing work-related musculoskeletal disorders (MSDs), resulting in pain, an inability to work, and high costs for the company in terms of compensation, productivity losses, and the replacement of personnel. Ensuring the health of production workers and decreasing the risk of work-related injury is a complex endeavour that is handled very differently by different organizations, depending on their means, resources, and view of ergonomics (Berlin, 2011).

Aroian and Awaijan (2022) opined that the rate of competition for businesses is becoming more intense nowadays, and therefore, more competitors are trying to satisfy their customers. In the industry world, the need for different products is increasing, and companies thereby must meet the demand. As demands increase, companies need to produce more products than usual, putting the health and well-being of their workers at risk. This is applicable in the electrical industry. The rate of demand for electricity is increasing day by day due to the increase in technology, advancements in industrialization, and demand for smart cities. Therefore, the electrical industrial workers are tasked with meeting the demands of consumers while focusing on and caring for their safety. There are several factors that need to be considered, such as workplace design, in order to improve productivity. These

factors are needed to protect employees from health problems and accidents that can take place during working hours. Therefore, workplaces must be designed according to ergonomic aspects (Anghel et al., 2019).

Ergonomics is defined as the study of science applied to make the aspects of a work environment suitable for different groups of people (Aroian & Awaijan 2022). Ergonomics is a human engineering discipline that addresses the effect that work environments and tasks have on employees. The idea behind ergonomics is to understand the pressure and stress that are exerted on different parts of the body as a consequence of specific tasks and to identify, prevent, or alleviate injuries that can result from these actions (Keller, 2010). The aim of ergonomics is to achieve an optimal relationship between employees and their working environment. Two major conflicting factors must be considered to be able to reach this optimum point. On the one hand, managers and companies require the highest levels of efficiency and productivity, and on the other hand, employees need comfortable and safe workplaces that ensure their health and physical well-being (Katiraee et al., 2021).

Every human is considered to have the ability to be proactive, reactive, flexible, innovative, and creative when they have an enabling working and safety environment. Nonetheless, the human body could easily be hurt or injured due to overloaded physical work and thus develop musculo-skeletal disorders (MSD) (Berlin & Adams, 2017). MSD is defined as "a disorder of the muscles, tendons, peripheral nerves, or vascular system not directly resulting from an acute or instantaneous event (slips or falls)" by the World Health Organization (WHO). Therefore, the main goal of the ergonomics field is to ensure safety and provide well-being to workers and employees (Karltun et al., 2017).

Musculoskeletal disorders (MSDs), including carpal tunnel syndrome (CTS), are an example of work-related ergonomic injuries that account for 14% of doctor's visits and 19% of hospital stays nationwide. Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs (Centers for Disease Control and Prevention, 2021). According to the National Research Council and the Institute of Medicine (2001), the Centers for Disease Control and Prevention (2021) noted that musculoskeletal disorders account for nearly 70 million physician office visits in the United States annually and an estimated 130 million total health care encounters, including outpatient, hospital, and emergency room visits. The Bureau of Labor Statistics of the Department of Labor defines MSDs as musculoskeletal system and connective tissue diseases and disorders when the event or exposure leading to the case is bodily reaction (bending, climbing, crawling, reaching, twisting), overexertion, or repetitive motion. MSDs do not include disorders caused by slips, trips, falls, or similar incidents (Centers for Disease Control and Prevention, 2021). Examples of MSDs include: sprains, strains, and tears; back pain; carpal tunnel syndrome; and hernia (Centers for Disease Control and Prevention, 2021).

Of the people who develop MSDs, 62% report some degree of activity limitation. Repetitive stress injury (RSI) is a comprehensive term for a variety of disorders that cause damage to tendons, nerves, bones, and muscles due to the repeated performance of a limited number of physical movements. Some of the symptoms of RSI are numbness, tingling, pain, swelling, burning, loss of dexterity, and muscle weakness. Other terms associated with RSI include cumulative trauma disorder (CTD), occupational overuse syndrome (OOS), repetitive motion syndrome (RMS), CTS, and tendonitis. Repetitive stress injuries cost employers over $80 billion a year. Just the average compensation of an employee suffering from CTS is $33,000.00 (Keller, 2010). Repetitive strain injury (RSI) is a general term used to describe the pain in muscles, nerves, and tendons caused by repetitive movement and overuse. One of the most common parts of the body that is affected by RSI is the hand. When you tense a muscle to just 50% of its ability, the blood flowing through the capillaries in the muscle can be completely shut off. Repeated tensing of your hand can cause the fibers of the tendons running through the carpal tunnel to separate or break. This causes friction between the tendon

and its sheath and ultimately results in tendonitis. Typical early symptoms include numbness, tingling, or burning sensations in the fingers, hands, forearms, elbows, and even the shoulder and neck. Ask anyone who has put off having carpal tunnel surgery, and they will tell you that this condition can become crippling. Victims of full-blown RSI have reported that they cannot wash their own hair or even hold a sheet of paper without agonizing pain (Keller, 2010). Most of the activities in electrical industries have to do with uses of muscle and repeated activities.

Installation and maintenance of electrical machines, devices, and wiring systems on industries and sites often require an electrical worker to work with their hands at or above shoulder height. Overhead work can cause MSDs such as tendonitis of the shoulder, and lifting can cause MSDs of the back and shoulders. The worker may also experience neck pain or injury because the neck is frequently in an extreme position during overhead work to allow the worker to see what he is doing. Electricians who install and maintain temporary wiring systems can develop rotator cuff tendonitis, low back pain from lifting materials overhead, and tension neck syndrome. As a craftsman, electrician, electrical engineer, or electrical technologist, if you are still not convinced that any of this pertains to you, then maybe we should look at some of the causes of repetitive stress injuries. These include repetitive wrist extension, flexing, and thrust necessary to grip wire strippers, screwdrivers, and other hand tools.

An assembly line usually consists of repetitive tasks that a worker has to complete, which involve bending, gripping, holding, reaching, twisting, etc. (Digiesi et al., 2018). Also, some tasks can include a crouching position due to the need to work under an object, which results in pain in different parts of the human body, such as the neck, back, feet, and ankles (Gonen et al., 2016). Even though human beings have the flexibility to perform these repetitive tasks, it is still considered dangerous in terms of their health, and It could lead to plenty of issues in the long term (Digiesi et al., 2018). The main concern in terms of a worker's health is the great risk of harm that leads to MSDs. Therefore, there is need to assess the impact ergonomic

Research Question

1. What is the ergonomic risk that electrical worker face in their daily work in electrical industry?
2. What are the effects of ergonomic risk on electrical workers in electrical industry?
3. What are the strategies of reducing ergonomic risk on electrical workers in electrical industry?

Research Methodology

The study adopted a descriptive survey research design. Descriptive survey research, according to Salaria (2012), is to carry out a study that includes proper analysis, interpretation, comparisons, and identifying trends and relationships in a part or sample of the population so that the result can be generalized to the entire population. The study was carried out in north Central Nigeria. The population of the study was 60 electrical linemen. Simple random sampling techniques was used to select three states from North Central Nigeria. The states are: Kwara State, Kogi State, and Niger State. Purposive sample was used to select 20 respondents from the sampled states. Data was collected using a structured questionnaire developed by the researchers.

Questionnaire was used for data collection. The instrument consists of four sections (A, B, C and D). Section A consist of the respondent's personal information. Section B, C and D consist of items 5, 6, and 8 which address the three research questions. Statistical Package for Social Sciences (SPSS) version 27 was used to analyze the data. The data collected from respondents was analyzed using mean statistics and standard deviation. The mean statistics and standard deviation were used to answer the research questions,

S/N	Scale of R.Q 1 & 3	Scale of R.Q 2	Point
1	Strongly Agree	Strongly Effect	3.50 – 4.00
2	Agree	Effect	2.50 – 3.49
3	Moderately Agree	Moderately Effect	1.50 – 2.49
4	Disagree	Not Effect	0.50 – 1.49

Research Question 1

What is the ergonomic risk that electrical worker face in their daily work in electrical industry.

Table 2: The mean and Standard Deviation of the response of electrical line men workers on the ergonomic risk that electrical worker face in their daily work in electrical industry.

S/NO	ITEM DESCRIPTION	*X*	SD	RM
1	Lifting Heavy Loads	3.40	0.81	A
2	Repetitive Hand and Wrist Motions	2.90	0.95	A
3	Awkward Posture	3.10	0.95	A
4	Prolong Standing or sitting	3.60	0.67	SA
5	Repetitive Bending and stooping	3.00	0.64	A
	GRAND MEAN	**3.20**	**0.80**	**A**

Keys: *X* Mean, SD= standard deviation, SA= Strongly Agree and A=Agree

Table 2 shows that items 1, 2, 3, and 5 fall within the range of agreed (2.90–3.40), while item 4 has its mean values within the range of strongly agreed (3.67). The result further shows that the grand mean is 3.20, which falls in the agreed range. The table equally shows that the standard deviations (SD) of all items are within the ranges of 0.64 to 0.95 and are positive and less than the normal deviation of 1.96, thereby indicating that respondents were not too far from the mean and from one another in their responses.

Research Question 2: What are the effects of ergonomic risk on electrical works in electrical industry?

Table 3: The mean and Standard Deviation of the response of electrical line men workers on the effects of ergonomic risk on electrical works in electrical industry.

S/NO	ITEM DESCRIPTION	*X*	SD	Remarks
1	Musculoskeletal Disorders	3.60	0.67	SE
2	Chronic Pain	3.10	0.95	E
3	Reduced productivity	2.80	0.88	E
4	Increased Healthcare costs	3.00	0.90	E
5	Work-related disability	3.40	0.81	E
6	Stress	3.62	0.54	SE
	Grand Mean	**3.25**	**0.79**	**E**

Keys: *X* = Mean, SD= Standard Deviation, SE= Strong Effect and E=Effect

Table 3 shows that items 2, 3, 4, and 5 fall within the range of effect (2.80–3.48), while item 1 and 6 have their mean values within the range of strong effect (3.60-3.62). The result further shows that the grand mean is 3.25, which falls in the agreed range. The table equally shows that the standard deviations (SD) of all items are within the ranges of 0.67 to 0.95 and are positive and less than the normal deviation of 1.96, thereby indicating that respondents were not too far from the mean and from one another in their responses.

Research Question 3

What are the strategies for reducing ergonomic risk for electrical workers in the electrical industry?

Table 4: The mean and standard deviation of the response of electrical linemen workers on the strategies of reducing ergonomic risk for electrical workers in the electrical industry.

S/NO	Item description	X	SD	RM
1	Rotate employees time to time so that no one person is exposed to the same activity for too long.	2.70	1.28	A
2	Team Work	3.44	0.84	A
3	One person holds an item while the other person installs it.	2.80	1.18	A
4	Taking regular break	3.00	1.19	A
5	Be sure to use the proper and right tools for the right job	3.06	1.04	A
6	Consider the workers' perspective and keep them in mind when ever building and setting up industries.	3.30	1.02	A
7	Ensure comfortable working postures	3.06	1.02	A
8	Less workload	2.60	1.12	A
	Grand Mean	**2.99**	**1.09**	**A**

Keys: X= mean, SD = standard deviation, and A= agreement.

Table 4 shows that all the items fall within the range of agreed (2.60–3.44), while the result further shows that the grand mean is 2.99, which falls in the range of agreed. The table equally shows that the standard deviations (SD) of all items are within the ranges of 0.84 to 1.28 and are positive and less than the normal deviation of 1.96, thereby indicating that respondents were not too far from the mean and from one another in their responses.

Major Findings of the Study

The major findings of the study are:

1. All the listed ergonomic risks are agreed to be ergonomic risks faced by electrical workers daily in the electrical industry.
2. All the listed ergonomic risks negatively affect electrical workers in the electrical industry.
3. There are strategies for reducing ergonomic risk for electrical workers in the electrical industry.

Discussion of Findings

The research question one is the answer to the ergonomic risk that electrical workers face in their day-to-day activities in electrical industries. There is a lot of risk in the electrical industry that many workers think little of. The study revealed that among the risks that electrical workers faced like other workers in other industries was the ergonomic risk. These ergonomic risks are: lifting heavy loads; repetitive hand and wrist motion; awkward posture; prolonged standing or sitting; and repetitive bending and stooping. The study by Ndiwa (2019) agreed with this study by identifying some of the ergonomic risks faced by industrial workers, such as awkward postures, manual handling of materials, repetitive motion, and forceful exertion. As supported by Berlin (2011), who revealed that cumulative trauma disorder was caused by repetitive motion of the hand, constrained body posture, and excessive mental stress. In agreement with the study, Ajayi and Adeoye (2018) noted that forceful exertion, repetition of work, awkward posture, vibration, and duration of work are some of the ergonomic risks faced by construction industry workers. This is an indication that industrial workers face almost the same ergonomic risk at work on a daily basis. The study of Yang (2019) buttressed this study by revealing that today, the risk factors for work-related ill health include not only high physical load but also

static load and a lack of physical activity. This is an indication that when the body system is active and in motion beyond its capacity, it could cause problems for the body; likewise, when the body is inactive, it could also affect the body negatively. Therefore, there is a lot of risk in the electrical industry that could cause both short- and long-term harm to workers.

The research question 2 revealed the effects of some of the ergonomic risks experienced by electrical workers in the electrical industry. The following effects are a result of ergonomic risks in the electrical industry: Musculoskeletal disorders; chronic pain; reduced productivity; work-related disability; stress; and more. It is little wonder that some of the retired electrical industrial workers are always complaining about pain, and some are deformed or stressed. The ergonomic stress can lead to poor health and the inability to carry out household and leisure-time activities, causing individual suffering. Stress is one major ergonomic challenge faced by electrical workers after several endavours or endurances. It is noted that whenever anybody is faced with stress, it has the ability to affect their perception, decision-making, and response selection. Aroian, and Awaijan (2022) agreed with the study and noted that job strain is a factor that plays a great role in affecting the human body and mind. In other words, the higher the job strain, the greater the risk of illness. One of the most common risks of job strain is the cause of MSDs. In harmony with the study, Keller (2010) posits that all electricians have to pull some kind of wire. Larger-gauge wire requires greater exertion to pull due to its increased weight and stiffness. Keller stressed further that this effort causes stress on hands, arms, shoulders, and backs and increases the risk of puncture injuries and falls. Ndiwa (2019) also concurred with this study, noting that fatigue, hand/palm pain, general body aches, wrist pain, shoulder pain, back pain/waist pain, sore muscles, and joint pain are associated with ergonomic risk in industrial workers. Yang (2019) noted that ergonomics deals with both physical, cognitive, and organizational. Therefore, the ergonomic risk faced by electrical workers may result in pain, death, disability, inability to work, and high costs for the company in terms of compensation and hospital bills, production losses, and replacement of personnel. It could as well lead to poor quality work and reduce productivity.

The research question 3 revealed some of the strategies for reducing ergonomic risk in the electrical industry for workers, such as rotating employees from time to time so that no one person is exposed to the same activity for too long, teamwork, less workload, and ensuring proper working postures using the proper and right tools for the right job. In harmony with this work, Keller (2010) revealed that poorly designed hand tools force you to use awkward grip postures that can result in tendonitis in your hands, wrists, and elbows. Even using a screwdriver for a long period of time can cause damage to your joints and tendons. Also, the study of Ajayi and Adeoye (2018), which agreed with this study, noted that to avoid overloading the muscular system, train the individual to use the workplace facility and equipment properly, workers should be allowed to do their tasks in rotations to reduce fatigue and also reduce static posture, and workers should use personal protective equipment, which will reduce the ergonomic risk in industry. As agreed with the study by Martin (2006), taking regular breaks and breaking tasks into shorter segments. This will give muscles adequate time to rest. Working through breaks increases the risk of MSDs and accidents and reduces the quality of work because employees are over-fatigued. Moreover, Bai et al. (2020) also mention that a healthy working environment results in higher productivity, which the worker's satisfaction plays a role in achieving. Therefore, there is a need to ensure that the working environment is well designed to improve workers posture, comfort, and convenience. There should be enough lighting and ventilation while working.

Conclusion

The study was based on the ergonomic risk faced by electrical workers in electrical industries in north-central Nigeria. It was revealed that there are a lot of ergonomic risks that seriously endanger the lives of electrical workers. This ergonomic risk is sometimes

neglected by both employers and employees of the electrical industry. There are a lot of negative impacts on the health of electric workers, such as musculoskeletal disorders, chronic pain, work-related disabilities, stress, and many more. It was revealed that these ergonomic risks could be reduced through teamwork, taking regular breaks, having less workload, being sure to use the proper and right tools for the right job, and ensuring comfortable working postures. When the above strategies are well observed, it could go a long way toward reducing the health challenges faced by electrical workers in the electrical industry.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Electrical workers should be taken into consideration when they are setting up the electrical industry.
2. There should be awareness of the ergonomic risks for electrical workers in the electrical industry. This will assist the electrical workers in being fully aware of the ergonomic risks in the industry.
3. Workshop or seminars should be organized by the head of electrical industries on how to reduce ergonomic risk among electrical workers.

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