



EFFECTS OF ERGONOMIC INTERVENTION APPROACH ON SOME OCCUPATIONAL HAZARDS IN AUTOMOBILE WORKSHOP IN SOUTH WESTERN NIGERIA

W. A. Adesope^{1*}, A. S. Onawumi², S. K. Adeyanju¹, A. O. Ajayeoba², O. R. Oyetunji², M. O. Fajobi^{3,4} and M. Ogunremi¹

¹Department of Mechanical Engineering, Oyo State College of Agriculture and Technology, Igboora, Nigeria.

²Department of Mechanical Engineering, Ladoke Akintola University of Technology, Ogbomosho, Nigeria

³Department of Mechanical Engineering, University of Ilorin, Ilorin, Nigeria

⁴Ladoke Akintola University of Technology, Open and Distance Learning Centre, Ogbomosho, Nigeria

*Corresponding author's email address: engrwhaliy@gmail.com

ARTICLE INFORMATION

Submitted 08 April, 2024

Revised: 30 June, 2024

Accepted: 10 July, 2024

Keywords:

Auto-repair technicians

Occupational hazards

Ergonomic hazards

Safety

Personal protective equipment

ABSTRACT

Automobile workshops house the auto-mechanic, auto-electrical, painting, and panel-beating units. Activities carried out in these units expose the workers to some occupational hazards and some musculoskeletal risk factors with perceived consequences on their health. Therefore, this study assessed selected automobile workshops within southwestern Nigeria to establish the prevalence of ergonomic hazards. A sample size of 496 auto-repair workshops (auto-mechanic, auto-electrical, painting, and panel-beating units) was randomly considered. Data was collected using observation, interaction, and structured questionnaires. The structured questionnaires were administered to the respondents to seek their demography and occupational hazards information. Standard weighing scale and stadiometer were used to collect the weights and status of the respondents, respectively. Some of the common hazards identified in the auto-repair workshops are poor workstation design, poor equipment and tool layout, noise, wet floors, poor lighting, and an unguarded working area, which often lead to slips, trips, and falls, muscle strains, equipment accidents, overexertion injuries, and scald injuries, among others. Common occupational risk factors in different workstations across the workshops visited were identified and ranked to establish their prevalence as non-usage of personal protective equipment, PPE, awkward posture, repetitive motion, repetitive manual tasks, and exposure to sharp objects. However, panel beaters (55%) and auto-mechanic technicians (49%) have the highest percentage of people who are normal weight, while painters (62%) and auto-electricians (38.5%) have the highest percentage of people who are above normal weight. Quick Exposure Check, QEC results showed that lower back pain and neck pain are the most prevalent musculoskeletal disorders (MSDs) and are majorly caused by awkward posture at work in an auto-repair workshop. According to this study, vehicle repair professionals were exposed to a variety of risks and hazards, with the lower backs of the workers being the most severely impacted. Auto-mechanical technicians in auto-repair workshops are most at risk.

© 2024 Faculty of Engineering, University of Maiduguri, Nigeria. All rights reserved.

1.0 Introduction

Occupational health has been described as an area in public health that deals with the provision and maintenance of the highest degree of physical and mental well-being of employees in the work system. It also has to do with the prevention of health hazards resulting from unsafe working conditions that workers are subjected to. Another peculiarity of occupational health is that it facilitates the protection of workers from the adverse effects of risk factors prevalent in the workplace. Park (2005) defined occupational health as the

adaptation of work to man, as well as the adaptation of each man to his job. In the discharge of their duties, workers often interact with various work tools and machinery. It is highly imperative, that the workplace configuration match the capability and ability of the worker. Therefore, the protection of workers against work-related injuries and illnesses has over the years been an issue of great concern to employers, workers, governments, and every stakeholder in a typical workplace. A safe working environment, effectiveness, safety, and productivity have highly significant correlations with the physical, mental, and social well-being of employees. Similarly, cost savings are enhanced in the absence of health challenges, compensations, absenteeism, and the death of an employee (Hughes and Phil, 2007). The International Labor Organization stated that there are over 160 million cases of work-related disease and 340 million occupational accidents worldwide annually (ILO, 2022). These occupational accidents were classified as fatal or non-fatal, with victims frequently suffering from amputations, skin irritations, musculoskeletal disorders, cancer, mental and neurological illnesses, respiratory and cardiovascular diseases, and other injuries (Punnett and Wegman, 2004; Tadesse and Admassu, 2006; Adei *et al.*, 2011). The case of the auto-repair workshop is not an exemption. Hazards sourced from pollution, working conditions, accidents, and ergonomic problems are put into adequate consideration in the search for ergonomic and safety interventions, such that the potential hazards housed by the industry are mitigated or eliminated (Ferguson *et al.*, 2012). Gaining insight into the various occupational hazards posed by auto mechanic workshops calls for an ergonomic assessment of the workshops. This in turn will facilitate a clear understanding of the various activities carried out, the workplace configuration, the identification of hazards, and the required mitigating steps.

Many studies have been conducted to investigate the level of knowledge of employees as regards occupational hazards in their workplace. One such study carried out in South Korea showed that 95% of employees of automobile manufacturing plants had adequate knowledge of the various hazards in their workplace (Liu *et al.*, 2008; Shireen and Thangaraj, 2016). A study on a similar automobile assembly plant reported by Sharifian *et al.* (2011) showed that members of staff working at the welding section had adequate knowledge of the hazards from welding fumes as well as other health implications of such activities carried out in the plant. Also, employees in the body repair workshop of an automobile assembly company in the United States of America were quite aware of the negative health implications of the lead to which they were being exposed (Lilies *et al.*, 1982). A study carried out in Britain also established a high level of awareness among the workers in an automobile manufacturing company. Studies have also revealed that employees in small and medium enterprises are more liable to work-related hazards and risks (Schneider and Becker 2005). This poor awareness could be a result of inadequate resources, poor technical capacity, and the non-awareness of Occupational Safety and Health (OSH) standards (ILO, 2005).

Aliyu *et al.* (2009) studied the occupational hazards at Peugeot Automobile Nigeria Limited (PAN) in Kaduna, Nigeria. The study established that the employees were exposed to chemical fumes, noise pollution, chemical burns, injury by metal chips, eye problems, dry cough. An ergonomic assessment of some existing auto mechanic workshops in selected cities in the southwestern part of Nigeria was carried out to gain insight into the various occupational hazards in the workshops, evaluate the workplace configuration, and propose possible mitigating approaches.

2. Materials and Method

The study was carried out in the southwestern part of Nigeria, comprising six states. Five auto mechanic workshops were considered in the state capital of the study area. The coordinates of the locations of the workshops are Lagos (6.6337° N, 3.3573° E), Ibadan (7.2513° N, 3.5410° E), Abeokuta (7.1154° N, 3.3896° E), Osogbo (7.7964° N, 4.5764° E), Akure (7.2516° N, 5.2214° E), and Ado-Ekiti (7.6124° N, 5.2371° E). The population studied included the auto electricians, auto-mechanic technicians, painters, and panel beaters operating in the study area. The auto-repair workshops were purposely selected for the study because, aside from routine maintenance, they were more committed to the proper and adequate working of vehicles. Informed consent was obtained from the respondents after explaining the importance and need for the study to them. A stratified random sampling technique was used to select auto mechanics based on their workshop practice. Standard tables of sample size, confidence levels, and confidence intervals for random samples were used to determine the 496-sample size for this study (Cohen *et al.*, 2007). The respective sample proportion (n) obtained for each state of the study area is presented in Table 1.

A structured questionnaire was designed to gather the necessary data, and each respondent was made to attend to the particular sections of the questionnaire that pertain to their category of occupation. The questionnaire had four sections to facilitate data collection on demographic and personal information, risk factor identification and safety practices, musculoskeletal disorders, and possible remedies. This study used a stadiometer (Wall Mounted Measuring Tape, Model: 67033) to measure the stature (m) of the respondents

and a digital weighing system (Model: Beichen TCS-A) to measure the weights (kg) of the respondents. The resulting dataset for stature and weight was articulated to determine the body mass index (BMI), using Equation (1) (Sperrin et al., 2015), and the results were compared with Table 2 for analysis.

$$BMI = \frac{W}{H^2} \tag{1}$$

where W = weight (kg)
H = Stature (m)

Table 1: Population Size and Samples

S/N	State	Sample size (n)
1	Ibadan	104
2	Ogun	88
3	Lagos	120
4	Ado-Ekiti	80
5	Osogbo	32
6	Akure	72
	Total	496

Table 2: Body Mass Index Rating (Sperrin et al., 2015)

BMI	Weight Status
<18.5	Under-weight
18.5 – 24.9	Normal weight
25 – 29.9	Over-weight
≥30	Obesity

A sphygmomanometer (Model: CMS-08A) was used to measure the blood pressure of the respondents (Agrawal et al. 2010). Quick Exposure Check (QEC) and Rapid Entire Body Assessment (REBA) methods were used for the postural analysis of work-related musculoskeletal risk factors of the four groups (auto-electricians, auto-mechanic technicians, painters, and panel beaters) considered, and the results were compared with the scoring table shown in Table 3. A field investigation and on-the-spot observation of the dangers in these auto-repair workshops were conducted, and the workers’ occupational risk incidences were evaluated using the Risk Rating Matrix (RRM). Figure 1 was then used to assess the data collected from the questionnaires in terms of likelihood and consequences to calculate the risk scores or risk indices for each body component susceptible to accidents. The likelihood and consequence were multiplied to determine the risk score or risk index for each portion of the body susceptible to an accident. To implement RRM in a semi-quantitative style, numbers were allocated to each box of the matrix, and a straightforward scoring system was employed to express likelihood and consequence. However, these figures rose as the likelihood and seriousness of the consequences increased. As a result, Table 4 lists the necessary actions to be followed to prevent undesirable incidents. Equation 2 (Work Health and Safety, 2015) was used to compute the overall risk (OR), which was then calculated by comparing the results to the overall risk decision table in Table 5.

$$OR = \frac{\sum_{i=1}^n R_i}{N} \tag{2}$$

where R_i is the Risk index of an i th body part, N is the number of risks and n is the number of workers

Table 3: The QEC, REBA and RULA scoring table (Ajayeoba, 2019)

Quick Exposure Check scores		Final REBA Score		Final RULA Score	
QEC	Level Score	REBA Score	Risk level (Action)	Score (Action)	Risk level
<40 (L)	Satisfactory Low Risk	1	None (change not necessary)	1-2	Negligible (Acceptable)
41 – 50% (M)	Moderate Risk	2-3	Low (change may be necessary)	3-4	Low (Further investigation and changes may be needed)
51 – 70% (H)	High Risk (H)	4-7	Medium (change is necessary)	5-6	Medium (Investigation and changes required soon)
>70 (VH)	Very High Risk	8-10	High (change necessary and soon)	7	High (Investigation and changes required immediately)
		11-15	Very High (change necessary and urgent)		

CONSEQUENCES	LIKELIHOOD				
	Rare (1)	Unlikely (2)	Possible (3)	Very Likely (4)	Almost Certain (5)
Catastrophic (5)	Moderate (5)	Moderate (10)	High (15)	Critical (20)	Critical (25)
Major (4)	Low (4)	Moderate (8)	Moderate (12)	High (16)	Critical (20)
Moderate (3)	Low (3)	Moderate (6)	Moderate (9)	Moderate (12)	High (15)
Minor (2)	Very low (2)	Low (4)	Moderate (6)	Moderate (8)	Moderate (10)
Insignificance (1)	Very low (1)	Very low (2)	Low (3)	Low (4)	Moderate (5)

Figure 1: Risk rating matrix (Adebiyi et al., 2021)

Table 4: Actions required for the risk rating matrix results (Adebiyi et al., 2021)

Risk Level Rating	Required Action
Critical	Immediate action is needed. Access to the hazard should be restricted until the risk can be lowered to an acceptable level
High	Action needed quickly (within 1-2 days). The task should not proceed unless the risk is assessed and control
Moderate	Action is required this week to eliminate or minimize the risk.
Low	Action required within a reasonable time frame (2-4weeks) to eliminate or minimize the risk.
Very low	Risk to be eliminated or lowered when possible

Table 5: Overall risk decision (Adebiyi et al., 2021)

Risk Rating	Descriptor	Acceptability
20 – 25	Critical	Inacceptable
10 – 16	High	Likely to be unacceptable
5 – 9	Medium	Could be Acceptable
3 – 4	Low	Acceptable
1 – 2	Very low	Very acceptable

3. Results and Discussion

Four hundred and ninety-six copies of the structured questionnaire were administered and retrieved from the sampled respondents of the selected automobile workshops such as auto-mechanic, auto-electrical, panel beating, and painting units.

3.1 Demographic Characteristics of the Respondents

Demographic characteristics of the sampled respondents are presented in Table 6, and it was revealed that 99.1% of the respondents are male and 0.9% are female. This justifies that auto-mechanic technician's job requires high strength and energy and may be difficult for females to do. A larger proportion of auto technicians, 50.9%, were between the ages of 20 and 39. This indicates that the majority of those who work in auto mechanic workshops are in their active years and have a high level of strength as well as the capacity to carry out their jobs. This has a positive impact on the economy because the younger generation is more likely to work because it creates job opportunities for them. Only 5.4% of the respondents were in the age range of 13–19 years. This may be a result of school dropouts and can increase the risk factor in auto-repair workshops. It can reduce the effectiveness of safety practices due to little or no education and a few years of working experience. 43.7% of the respondents are within the age range of 40–59 years, all of whom are adults.

3.2 Common Hazards and Incidences in Auto-Repair Workshops

The common hazards identified in the auto-repair workshops are poor workstation design, poor equipment and tool layout, noise, wet floors, poor lighting, bad tools, wrong tools and equipment, an unkept environment, and an unguarded working area. These hazards can be grouped into biological, safety, chemical, mechanical, physical, ergonomic, and psychological hazards. These often lead to slips, trips, and falls; muscle strains; being hit by falling objects; crashes and collisions; cuts and lacerations; inhaling toxic fumes; machine entanglement; equipment accidents; overexertion injuries; and scald injuries. Table 7 shows that the hazards, risk factors, and incidences are consistent with the findings of other researchers. Thus, for effective control of these common hazards, the hazards must completely remove as recommended by the hazard hierarchy of controls presented in Figure 2 (Morris and Cannady 2019). However, the least that should be done is to use personal protective equipment (PPE) to avoid any form of incident.

Table 6: Demographic profile of respondents

Category	Auto electrician	Auto mechanic	Panel beater	Painter
N	92	128	92	92
Gender				
Male	100.0	95.6	100.0	100.0
Female	0.0	4.4	-	-
Age				
13-19	9.3	4.4	8.0	4.8
20-39	39.5	51.1	44.0	57.1
40-60	51.2	44.5	48.0	38.1
> 61	-	-	-	-
Educational Level				
Primary SC	58.1	40.9	24.0	28.6
SSCE	27.9	22.6	28.0	33.3
OND	-	9.5	-	-
HND	-	-	-	-
BSC	-	-	4.0	-
None	14.0	27.0	44.0	38.1
Read or write				
Yes	76.7	64.2	44.0	42.9
No	23.3	35.8	56.0	57.1
Work Hours per Day				
1-3	-	-	-	-
4-7	-	4.4	4.0	19.0
7-10	100.0	95.6	96.0	76.2
10-13	-	-	-	4.8

Note that responses of each item sum up to 100%

3.3 Auto-Repair Workshop Activities

Investigations revealed that the major activities being carried out in the selected workshops are those of auto-mechanic, auto-electrical, painting, and panel beating. Analysis showed that auto-mechanic activities were the

most common, with a total percentage of 25.8%, as against 18.5% for each of the others. This shows the peculiarity of the activities involved in the smooth running of vehicles.

3.4 Prevalence of Common Risk Factors in Auto-Mechanic Workshops

Common occupational risk factors in different workstations across the workshops visited were identified and ranked to establish their prevalence as non-usage of PPE, awkward posture, repetitive motion, repetitive manual tasks, and exposure to sharp objects. Table 8 shows the risk factors from the highest to the lowest according to the analysis of the responses of the workers. Thus, the solutions to any workplace injuries caused by these risk factors are to keep the workshop simple, participate in proper housekeeping, be organized, be stable at work, avoid jumping safety rules, use your PPE regularly, avoid taking shortcuts and be safety conscious.

Table 7: Findings of other researchers as regards the study in Nigeria

Author	Workforce	Location	Risk Factors/hazards/Incidences
Awodele <i>et al.</i> (2014)	Paint factory workers	South western, Nigeria	Inadequate use of personal protective equipment
Adeyemi, <i>et al.</i> (2016)	Workers of automobile service and repair industry	South western, Nigeria	Frequent lifting of automobile components, standing for long period of time at work, work in uncomfortable postures for very long time daily, forceful gripping of components and/or working tools
Elenwo (2018)	Automobile mechanics	South southern, Nigeria	Biological, chemical, mechanical, physical and psychological
Johnson and Etokidem, (2019)	Butchers	South southern, Nigeria	Inadequate use of appropriate protective wears. Inappropriate de-furring methods
Okon, <i>et al.</i> (2019)	Chainsaw operators	South eastern, Nigeria	Hit by dead trees/branches, fall, machine chain cuts/kick-back, rolling log, snake, bite from bees
Afolabi, <i>et al.</i> (2021)	Automobile artisans	South western, Nigeria	Inadequate use of personal protective equipment
Olanrewaju, <i>et al.</i> (2021)	Automobile repair artisans	North central, Nigeria	Pulling heavy weight object, Lifting heavy weight object, Pushing heavy weight objects, Holding Heavy weight objects, Carrying heavy weight object
Onawumi <i>et al.</i> (2022)	Automobile repairs workmen	South western, Nigeria	No usage of sign post, Unavailability of safety equipment, Ignorance of the usage of personal protective equipment, Inability to manage work load demand, Ignorance on the essence and importance of adequate body treatment, Untidy and unventilated workspace and environment.
Ozomata <i>et al.</i> (2022)	Automobile mechanics	South western, Nigeria	Burns from various sources, Cuts, Sharp edges of hand tools and vehicle parts, Eye injury from flying objects, Fracture from fall of heavy objects, Crushed finger/ toes from moving machine parts

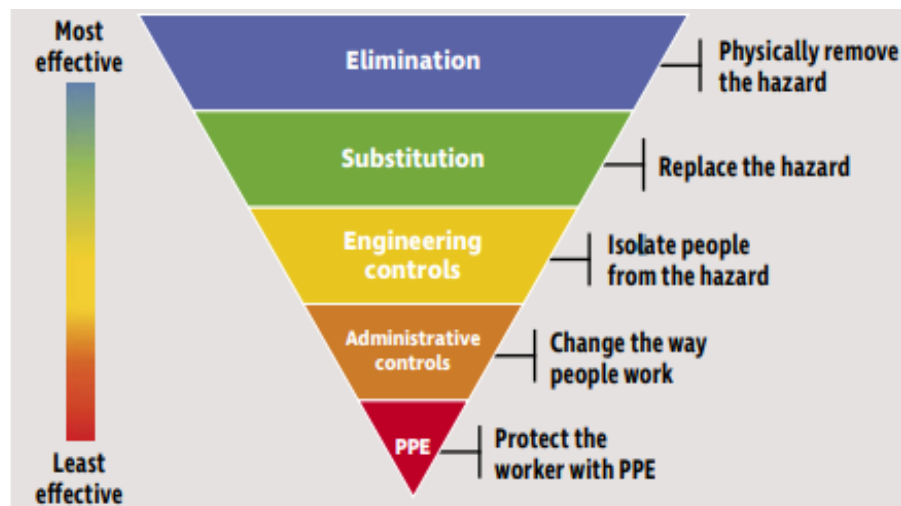


Figure 2: Hazard hierarchy of controls (Morris and Cannady, 2019)

Table 8: Ergonomic risk factor of auto-repair workshops

Ergonomic Risk Factor			
Auto-mechanic Unit	Painting unit	Panel beating unit	Auto electrical unit
Non usage of PPE	Non usage of PPE	Non usage of PPE	Non usage of PPE
Awkward posture	Repetitive motion	Exposure to, flames, and hot surface	Awkward posture
Lifting heavy objects	Exposure to chemicals and particles	Exposure to sharp objects	Working in tight area
Repetitive manual tasks	Awkward posture	Exposure to chemicals and particles	
Working in tight area	Exposure to noise		
Exposure to gasoline/diesel exhaust			
Exposure to sharp objects			
Working under uncomfortable heights			
Exposure to fuel products			
Falling objects			
Exposure to battery acid, hot surfaces, etc.			
Exposure to high temperatures			
Exposure to noise			

3.5 Body Mass Index

Panel beaters (55%) and auto mechanics (49%) have the highest proportion of personnel with normal weight, while painters (62%) and auto electricians (38.5%) have the highest proportion of technicians who are overweight (Figure 3). Technicians (Painters and auto-electricians) were heavier than average because painting and auto-electrical activities did not require as much strenuous, repetitive, and awkward posture activities as others, as opposed to normal weighted technicians (Panel and auto-mechanic).

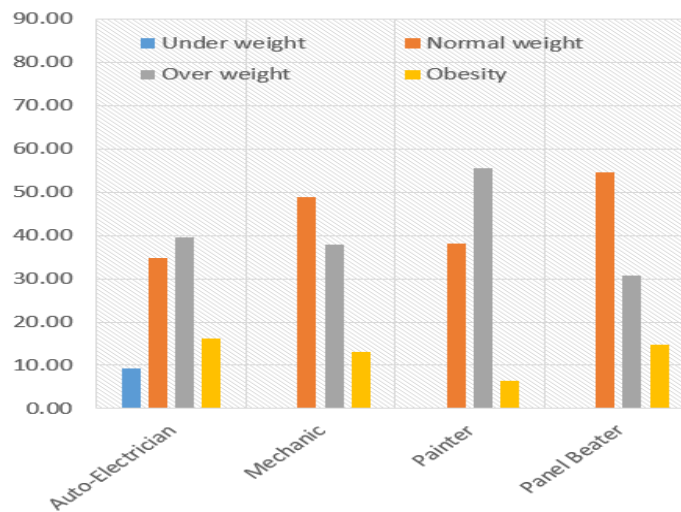


Figure 3: Comparison of BMIs for all the categories

3.6. Risk Assessment Analysis

The QEC results in Table 9 show that lower back pain and neck pain are the most common MSDs and are majorly caused by the awkward posture at work in an auto repair workshop. Thus, 53, 33, 44, and 41% of the auto-mechanic technicians, auto-electricians, panel beaters, and painters, respectively, are working above the medium musculoskeletal risk level.

Table 9: QEC results of risk factors assessment of the Auto-Repair Technicians

Body Part	Auto-Mechanic Technicians				Auto-Electricians				Panel Beaters				Painters			
	L	M	H	VH	L	M	H	VH	L	M	H	VH	L	M	H	VH
Upper arms	28	45	25	2	18	53	25	4	15	31	48	6	13	41	44	2
Shoulder	12	30	55	3	17	56	27	0	24	33	40	3	20	43	34	3
Neck	8	24	63	5	15	29	54	2	13	30	55	2	12	33	54	1
Thigh/Legs	14	61	24	1	40	43	17	0	40	43	17	0	33	49	17	1
Wrist/Lower arm	9	27	59	5	12	51	37	0	12	51	37	0	10	48	41	1
Lower Back	6	17	72	5	18	53	25	4	15	31	48	6	14	38	46	2

L=low, M=medium, H=high and VH=very high musculoskeletal risk level

The results in Table 10 revealed that 88, 62, 79, and 36 percent of the auto-mechanic technicians, auto-electricians, panel beaters, and painters, respectively, have a musculoskeletal risk level above the medium level; thus, change is necessary soon. The results also showed that auto-mechanic technicians have the highest risk level, while painters have the lowest. The detailed risk index assessment results and the overall risk level of auto-repair workers (Tables 11 and 12) also validated the QEC and REBA results that auto-mechanic technicians and panel beaters have the highest risk level.

Table 10: Final REBA scores of the workers at the auto-repair workshop

REBA Risk level Score	Auto-Mechanic Technicians	Auto-Electricians Technicians	Panel Beaters	Painters
1				
2-3				
4-7	0	4	2	5
8-10				
11+				
2-3	0	17	3	21
4-7	12	17	16	38
8-10	45	41	41	29
11+	43	21	38	7

Table 11: Overall risk level of auto-repair workers

Risk Level	Risk Rating	Condition	Auto-Mechanic Technicians	Auto-Electricians	Panel Beaters	Painters
Critical	20 – 25	Inacceptable	-	-	-	-
High	10 -16	Likely to be unacceptable	10	-	-	-
Moderate	5 – 9	Could be acceptable	-	6	8	5
Low	3 – 4	Acceptable	-	-	-	-
Very low	1 – 2	Very Acceptable	-	-	-	-

Table 12: Detailed risk index assessment results of auto-repair workers

Auto-Repair Workers	Body part	Very low	Low	Medium	High	Critical
		%	%	%	%	%
Auto-Mechanic Technicians	Upper arms	3	20	41	32	4
	Shoulder	5	12	49	30	4
	Neck	4	13	60	20	3
	Thigh/Legs	5	17	23	54	1
	Wrist/Lower arm	1	9	21	57	12
	Lower Back	0	7	18	71	4
Auto-Electricians	Upper arms	11	19	48	22	0
	Shoulder	7	18	51	23	1
	Neck	7	21	39	35	0
	Thigh/Legs	11	35	42	12	0
	Wrist/Lower arm	7	18	52	23	0
Panel Beaters	Lower Back	9	17	45	26	3
	Upper arms	3	18	29	42	8
	Shoulder	5	28	41	24	2
	Neck	1	15	27	54	3
	Thigh/Legs	1	25	36	36	2
	Wrist/Lower arm	2	14	34	49	1
	Lower Back	1	13	28	53	5
Painters	Upper arms	3	14	35	47	1
	Shoulder	4	21	38	35	2
	Neck	3	14	38	43	2
	Thigh/Legs	1	30	45	22	2
	Wrist/Lower arm	3	12	47	38	0
	Lower Back	1	13	35	47	4

4. Conclusions

This study has established that the auto-repair workers were exposed to various hazards and risk factors, while the lower backs of the workers were mostly affected. Auto-mechanic technicians have the highest exposure to these risks. Thus, constant training and retraining of workers on safety issues, the compulsory use of PPE, proper housekeeping, and following the safety rules will keep injuries and accidents at bay.

References

Abiola, OA., Oke, AO. and Koya, OA. 2018. Anthropometric Characteristics of Roadside Auto-Mechanics: A Case Study. Leonardo Journal of Sciences, 32: 105-122.

Adebiyi, KA., Bello, TO., Ajayeoba, AO., Aroyehun, AO. and Raheem, WA. 2021. Occupational Risk Assessment of Workers and Furnace Units in Steel Recycling Plants. *Adeleke University Journal of Engineering and Technology*, 4(1): 23 – 32.

Adei, E., Adei, D. and Osei-Bonsu, S. 2011. Assessment of perception and knowledge of occupational chemical hazards, in the Kumasi metropolitan spray painting industry, Ghana. *Journal Science Technology*, 31:83-94.

Adeyemi, HO., Akinyemi, OO., Musa, AI. and Ibikunle, BQ. 2016. Assessment of Work-Space and Work-Method Designs in Nigeria Automobile Service and Repair Industry. *Nigerian Journal of Technology*, 35(2): 321 – 328.

Afolabi, FJ., de Beer, P. and Haafkens, JA. 2021. Occupational Risk Perception and the Use of Personal Protective Equipment (PPE): A Study Among Informal Automobile Artisans in Osun State, Nigeria. *Sage Open* 1 – 10.

Agrawal, KN., Singh, RKP. and Satapathy, KK. 2010. Anthropometric Considerations of Farm Tools/Machinery Design for Tribal Workers of Northern Indian. *Agricultural Engineering International: CIGR Journal*, 12: 143-150.

Ajayeoba, AO. 2019. Risk, Postural and Physical Strain Assessment of Sawmill Workers in Nigeria. *International Journal of Engineering Research in Africa*, 45: 74 – 88.

Aliyu, AA., Shehu, AU. and Singha, P. 2009. Evaluation of occupational health services and hazards in a car assembly plant in Kaduna Nigeria. *Port-Harcourt Medical Journal*, 3(1): 349-353.

Attarchi, MS., Koochpayeh, J., Labfinejad, Y. and Mohammadi, S. 2009. Effect of exposure to low levels of organic solvent mixtures on colour vision. *Journal of Medical Council of Islamic Republic of Iran*, 27(3): 307-316.

Awodele, O., Popoola, TD., Ogbudu, BS., Akinyede, A., Coker, HAB. and Akintonwa, A. 2014. Occupational Hazards and Safety Measures Amongst the Paint Factory Workers in Lagos Nigeria. *Safety and Health at Work*, 1 – 6.

Cohen, L., Manion, L. and Morrison, K. 2007. *Research methods in education (Sixth edition)*. Taylor and Francis Group, Routledge, New York.

Elenwo, EI. 2018. Occupational Hazards and Risks of Automobile Mechanics in Port Harcourt Metropolis, Rivers State, Nigeria. *International Journal of Health, Safety and Environments*, 4(1): 156-167.

Hughes, P. and Phil, E. 2007. *Introduction to Health and Safety in Construction*. 2nd ed. Oxford, UK: Elsevier Ltd. p. 61.

Innime, R. and Chika, C. 2022. Occupational Hazards of Health Care Workers in Ikwerre Local Government Area of Rivers State Nigeria *Research Journal of Pure Science and Technology*, 5(1): 11 – 31.

International Labour Organization (ILO) 2022. World Statistic: The enormous burden of poor working conditions. https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang-en/index.htm

Johnson, OE. and Etokidem, AJ. 2019. Occupational hazards and health problems among butchers in Uyo, Nigeria. *Nigeria Medical Journal*, 60: 106-112.

Lilies, R., Valciukas, JA., Kon, S., Sarkosi, L., Campbell, C. and Selikoff, I. 1982. Assessment of lead health hazards in a body shop of an automobile assembly plant. *American Journal of Industrial Medicine*, 3: 33-51.

Liu, S., Liu, J. and Sun, J. 2008. Survey of occupational hazards in an automobile manufacturing company. *Journal of Environmental and Occupational Medicine*, 3(1): 295-297.

- Morris, GA. and Cannady, R. 2019. Proper Use of the Hierarchy of Controls. Professional Safety PSJ 37 – 40. assp.org.
- Okon, KE., Oworen, U., Daniel, KS. and Kufre, I. 2019. Occupational Hazards and Work Safety Among Chainsaw Operators in Nigeria Environment, 3: 8-20 DOI: 10.31058/j.envi.2019.33002.
- Olarewaju, SO., Sokan-Adeaga, AA., Awoaife, FB., Akinyele, CA. and Omobuwa, O. 2021. Assessment of Occupational Injuries and Safety Practices among Automobile Repair Artisans in Apo and Gudu Area of Abuja, Nigeria Journal of Epidemiological Society of Nigeria, 4(2): 71-86.
- Oluwatosin, FM. and Ojo, OS. 2018. ICT-Based Market Information Services Utilization by Small Scale Farmers in Southwest Nigeria. Rep Opinion, 9(2):82-89.
- Ozomata, EA., Osagiede, EF. and Onyebujoh, TJ. 2022. Occupational health hazards and use of personal protective equipment among automobile mechanics in Surulere local government area of Lagos State, Nigeria - A descriptive study. International Journal of Occupational Safety and Health, 12(1): 35 – 44.
- Park, K. 2005. Preventive and Social Medicine (18th ed.). Jabalpur: M/S Barnasidas.
- Punnett, L. and Wegman, DH. 2004. Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. Journal of ElectromyogrKinesiol, 14:13-2.
- Schneider, S. and Becker, S. 2005. Prevalence of physical activity among the working population and correlation with work-related factors: Results from the first German National Health Survey. Journal of Occupational Health, 47: 414-423.
- Sharifian, SA., Loukazadeh, Z., Shojaodding-Ardekani, A. and Aminian, O. 2011. Pulmonary adverse effects of welding fumes in automobile assembly welders. Acta Medica Iranica, 49(2): 98-102.
- Shireen, N. and Thangaraj, S. 2016. Occupational health hazards among automobile mechanics working in an urban area of Bangalore – a cross sectional study. International Journal of Medical Science and Public Health, 16(1): 18-22.
- Sperrin, M., Marshall, AD., Higgins, V., Renehan, AG. and Buchan, LE. 2015. Body mass index relates weight to height differently in women and older adults. Journal of Public Health, 1(1): 1 -35.
- Wang, L., Weng, S., Wen, S., Shi, T., Sun, G. and Zeng, Y. 2013. Polychlorinated dibenzo-p-dioxins and dibenzofurans and their association with cancer mortality among workers in one automobile foundry factory. Science of Total Environment, 443:104-111.