Original Research Article

A descriptive study of workplace risk assessment in the automobile sector of Uttarakhand, India

ABSTRACT

Aims: The auto sector in India contributes 7.1% of the country's GDP and is predicted to earn USD 810.3 billion by 2026. However, India has a greater death rate and poorer job safety than the United States, where industrial accidents happen 20 times more frequently. Musculoskeletal disorders are a significant cause of disability and accidents at work. The goal of the study was to evaluate the existing working conditions in the automobile industry, where mechanics play a crucial role in precision.

Study design: The present study was carried out in Uttarakhand at Udham Singh Nagar district, block Rudrapur; Nainital district, block Haldwani; and Almoradistrict,block Dwarahat. Purposive and random sampling techniques were used to select the study area and samples. The total 75 respondents and 14 garages were selected

Methodology: A checklist was developed to get information about the health status of garage workers, awareness of occupational hazards, use of personal protective equipment, risk assessment, and workplace analysis.

Results: The study reveals that UdhamSingh Nagar garages provide cent per cent PPE to their workers, while Nainital and Almora districts lack proper facilities. Nearly half of workers lack worksite cleaning facilities, slip-resistant floors, spray booths, dip tanks, and clean toilets. Additionally, a quarter of garages require adjustments to work height, foot platforms, item holders, work-rotation systems, hanging toolboxes, and hazardous chemical container labeling.

Conclusion: 7.1% of India's GDP is contributed by the auto industry, which is projected to generate $810.3 billion by 2026. In contrast to the US, the nation has a greater fatality rate and a worse level of workplace safety, and industrial accidents happen there 20 times more frequently. According to a survey conducted in Uttarakhand, whereas Nainital and Almora districts lack adequate amenities, Udham Singh Nagar garages offer cent per cent PPE to employees. There aren't enough clean restrooms, or there aren't enough slip-resistant floors for the majority of employees.

Keywords: Workplace, checklist, work-rotation,Automobile sector

1. INTRODUCTION

The fourth-largest automobile industry in the world is found in India. The country's auto industry generates 7.1% of its GDP. By 2026, it is anticipated that the demand for vehicle repair and maintenance services will reach USD 810.3 billion. Over the projection period, demand for automotive repair and maintenance services is anticipated to be driven by factors including an increase in the number of cars on the road, rising disposable income levels, the need for greater passenger safety in vehicles, and rising average vehicle ages.Compared to the UK, occupational accidents occur 20 times more frequently in India. While there were 144 work-related deaths in Britain in 2017 **(British Safety Council, 2019),**. there are an estimated 48,000 work-related deaths each year in India. The

International Labor Organization's **(ILO, 2018)** research states that the death rate among workers around the world is significantly increasing each year. Regarding workplace safety and health, it is around 6300 per day, and 2.3 million workers are lost each year.

Musculoskeletal diseases (MSDs) are one of the main contributors to disability and work-related accidents in industrialized and developing nations. While individual risk factors include poor work practices, poor nutrition, and/or unhealthy behaviours, workplace ergonomic risk factors include high task repetition, strong efforts, and repeated or extended unpleasant postures **(Middlesworth, 2016).** According to the CDC (CDC, 2001), MSDs are the leading cause of workplace injuries and represent over 30% of all employee compensation expenses. Poor health and safety regulations continue to affect all Indian workplaces. Low back pain, upper back discomfort, leg cramps, carpal tunnel syndrome, bursitis, and tendinitis were all reported symptoms of MSD.

Tongerge*net al.* (1995) developed a protocol that focused on the findings of a systematic study of the working environment in the Dutch rubber industry. Protocol based on the results and knowledge of an industry-wide hygiene report. It has made analyzing and monitoring unsafe working practices in rubber production plants easier. The focus was put on the measurement of sensitivity to particulate solvents and disturbance, dermal sensitivity to pollutants, exposure to vibration, harsh climatic conditions, deleterious working environments, risks to injuries, and unsanitary working practices.

Personal protection equipment (PPE) plays a crucial role in reducing exposure to industrial hazards among car technicians. **Motilewa*et al.* (2016)** found that overalls were the most widely recognized PPE by respondents, followed by boots and gloves for mechanics and panel beaters. A total of 122 (80.8%) respondents had a clear knowledge of PPE. **Gleeson(2001)** research on health and safety in the catering sector revealed high levels of injuries and illnesses, including work-related accidents and illnesses. The tetanus vaccine could help alleviate these issues, making it essential for catering companies to utilize occupational health facilities. **Aprekoet *al.* (2015)** stated that most respondents accepted that PPE was adequate to give them a degree of protection, but only 45.8% agreed that they were the prescribed garments in the workshop. Most respondents acknowledged that PPE is used to avoid the vulnerability of individual body parts to hazards. However, certain areas of the body were not covered by the use of PPE, such as the daily use of goggles to shield their eyes while operating and the use of breathing aids for treating hazardous products. This may be attributed to the versatility of the work of the respondents.The majority (64.9%) of the respondents either disagreed or were neutral about whether they felt comfortable using the PPE, and 68% disagreed or were neutral about the normal replacement of worn-out PPEs. Most respondents were sure that they should use the PPE properly. **Hanson (2003)** revealed that employees are expected to wear PPE in certain industrial conditions to shield them from hazards. Wearing any type of PPE in hot weather can increase the risk of heat strain, as most types of PPE have higher insulation.

Zahirian **et al. [2] s**uggested that PPE consumers would be those housewives who are vulnerable to high-risk household hazards or technologically unavoidable situations where the usage of PPE may be counteracted. It emerged that housewives and family members of their workers have failed to make the correct choice of uniform PPE due to inadequate workplace risk evaluation, the inability to advise employees on job results, solely economic concerns disregarding the need for safety, or a lack of knowledge from the manufacturer.

Joshi (2009) studied the usage of PPE among construction staff, the PPE design, and the redesign of selected PPE. Workers were observed to be vulnerable to impact from dropping items, intrusion by nails, scrap metal, sharp objects, biological, electrical, mechanical, heat and cold, and more for non-PPE wearers. Most staff reported experiencing discomfort due to inadequate clothing, constant sweating, skin irritation, decreased vision, agility, grip intensity, and the inability to use PPE spontaneously. **Okwabi R *et al.*(2016)** found that the majority of apprentices obtained practical instruction from their master craftsmen on the utility of PPE, and 90 per cent of staff replied that there is no strict oversight of the use of PPE. A workplace hazard is a danger encountered at work that includes environmental, biological, and psychosocial physical hazards. Short-term risks can include physical injuries, while long-term risks can increase the risk of contracting cancer or heart disease. Occupational hazards are working activities that can cause or increase the risk of injuries or ill health.

Table .1: Hazards related to automobile mechanic jobs according to the Israel Institute for Occupational Safety and Hygiene jointly with the BIA (Germany)

Accident hazards
• Falls from ladders, stairs, elevated platforms, etc., and falls into inspection pits
• Falls on the level, esp. on wet, slippery, or greasy garage floors
• Injuries due to collapse of jacking, lifting, or hoisting equipment and vehicles falling from lifting equipment
• Crushed toes resulting from falls from heavy objects
• Eye injury from splinters and flying objects from grinding and machining operations while operating compressed-air equipment and during cleaning and similar operations
• Injuries as a result of being caught in or between moving and stationary objects
• Injuries caused by rotating parts of machine tools
• Falls from ladders, stairs, elevated platforms, etc., and falls into inspection pits
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• Injuries as a result of being caught in or between moving and stationary objects
• Injuries caused by rotating parts of machine tools
• Acute musculoskeletal injuries (intervertebral disk rupture, hernia, etc.) due to overexertion while lifting or otherwise handling heavy vehicle parts, etc., and due to awkward work postures (under the vehicle, etc.)
• Burns due to contact with hot surfaces, exhaust pipes, or hot-melt chemicals; sudden release of hot water and steam lines; radiator and cooling system pipes; soldering, brazing, and welding operations, etc.
• Electrocution as a result of defects, short circuits, improper use of electromechanical equipment, or contact with live wires, e.g., • Electric shocks from portable power tools
• Carbon monoxide poisoning
• Fires and explosions of spilt or leaked flammable or explosive substances, or by the ignition of hydrogen released from batteries, or during flame cutting and welding operations, etc.
• Increased rate of road accidents during test driving
• Punctures and cuts caused by sharp edges of hand tools, vehicle parts, and sheet materials
• Bursting of compressed-air lines or containers
• Bursting of tires
• Accidents due to improperly installed and maintained steam and water pressure cleaners
Physical hazards
• Exposure to direct and reflected ultraviolet and infrared radiation (esp. from welding operations)
• Exposure to microwave and radiofrequency radiation (esp. in heat-sealing of panels and upholstery, drying of trim base panels, etc.)
• Exposure to hand-arm vibration from power-driven hand tools, resulting in the development of White Finger Syndrome, etc.
• Exposure to excessive noise (> 90 dBA), esp. in car bodywork, during engine testing, etc.
• Exposure to excessive heat or cold, esp. in open garages or during roadwork (the use of improvised heating may cause fire and CO poisoning),
Chemical hazards

Exposure to a wide range of industrial chemicals, including heavy metals contained in brake fluids, degreasers, detergents, lubricants, metal cleaners, paints, fuel, solvents, etc., results in various forms of chronic poisoning. • Skin diseases and conditions (various types of dermatitis, skin sensitization, eczema, oily acne, etc.) caused by various chemicals, e.g., adhesives, asbestos, antifreeze and brake fluids, epoxy resins, gasoline, oils, nickel, colophon, etc.
• Eye irritation, dizziness, nausea, breathing problems, headaches, etc., are caused by contact with irritating chemicals and their dust and fumes, e.g., antiknock agents (such as methylpentadienyl manganese tricarbonyl [MMT]), ketone solvents (such as methyl isobutyl ketone [MIK]), etc.
• Asbestosis and mesothelioma caused by asbestos dust from brake drum cleaning and processing operations
• Chronic poisoning resulting from exposure to lead and its dust and fumes (esp. while repairing radiators, handling storage batteries, welding, using paints and lubricants, etc.)
• Hematological changes as a result of exposure to solvents such as benzene and its homologs, toluene, xylene, etc.
• Increased risk of cancer due to inhalation of diesel exhaust fumes or contact with certain heavy metals and their compounds, such as asbestos, benzene, etc.
• Increased risk of organic brain damage due to inhalation of diesel exhaust fumes
• Acute eye and mucous membrane irritation, headaches, breathing difficulties, chest tightness, etc., caused by inhalation of NOx and respirable particulates
• Gastrointestinal disturbances as a result of accidental or chronic ingestion of adhesives
• Nuisance due to bad smells when working with certain solvent-based adhesives
• Splashes of corrosive and reactive chemicals that may cause eye and skin injuries, etc.
Biological hazards
• Infections as a result of microorganism contamination and growth in certain adhesives
Ergonomic, psychosocial, and organizational factors
• Acute musculoskeletal injuries (intervertebral disk rupture, tendon rupture, hernia, etc.) caused by physical overexertion and the incorrect combination of weight and posture during lifting and moving heavy loads
• Cumulative trauma disorders, including carpal tunnel syndrome, caused by long-term repetitive work
• The danger of being attacked by individuals (including dissatisfied customers) in workplaces open to the public
• Psychological stress when working under time pressure

Ahmad *et al.* (2017) analyzed data from local workshops and workshops of multinational companies. The mean positive response for OHS components was 47% in LWs and 84% in CWs. Personal protective equipment, fire protection, emergency services, equipment supply, electrical safety, general workplace safety, housekeeping, chemical exposure, maintenance, servicing, manual handling, and equipment care were the most popular. Overall, 47% of all OHS components in LWs were positive, consistent with standard practices and legislation.

2. MATERIAL AND METHODS

The current study was conducted in Uttarakhand, India in Udham Singh Nagar district, block Rudrapur; Nainital district, block Haldwani; and Almora district, block Dwarahat. Based on the convenience and availability, a purposive and random sampling technique was used. For descriptive data, 75 respondents and 14 garages were selected. A thorough understanding of primary knowledge was obtained using the semi-structured and informal interview methods.

For risk assessment, a checklist was used to identify whether personal protective equipment, fire protective equipment, medical services, first aid, and general work environment facilities were provided to the garage workers or not. The responses of the employees were collected in terms of

Yes or No, and the negative responses given by workers were considered as a basis for risk assessment. For the workplace assessment,the checklist was used whichwas introduced by KazutakaKogiand was established by IEA to prepare the basis for a joint review by the IEA and ILO, which was conducted at a workshop in Bali, Indonesia, in 2005.

3. RESULTS AND DISCUSSION

3.1 Risk assessment

Risk assessment is a term used to describe the overall process or method by which we can identify hazards and risk factors that have the potential to cause harm.

3.1.1 Provision of Personal Protective Equipment to Garage Workers

Table 2 shows that authorized garages inUdham Singh Nagar provided cent per centof personal protective equipment to their workers. Company-owned garages in Nainital provided cent per cent gloves and protective clothing, while fifty per cent did not provide hard hats and twenty-five per cent did not provide steel-toed shoes, goggles, or masks. Local garages in Almora district did not provide these items, and 87.5% did not provide masks, gloves, or protective clothing.

Table 2: Providing personal protective equipment to garage workers

		NAINITAL (n_1=4)		**ALMORA (n_2=8)**		**UDHAMSINGHNAGAR (n_3=2)**		**Total (n=14)**	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
1.	Gloves	100 %	-	12.5 %	87.5 %	100%	-	50%	50%
2.	Steel toed shoes	75%	25 %	-	100 %	100%	-	35.71 %	64.28 %
3.	Hard hats	50%	50 %	-	100 %	100%	-	28.57 %	71.42 %
4.	Goggles	75%	25 %	-	100 %	100%	-	35.71 %	64.28 %
5.	Mask	75%	25 %	12.5 %	87.5 %	100%	-	42.85 %	57.14 %

6.	Protective clothing	100 %	-	12.5 %	87.5 %	100%	-	50%	50%

3.1.2 Use of fire protective equipment

Table 3. shows that Udham Singh Nagar's authorized garage had a cent per cent fire alarm system and extinguisher, while twenty-five per cent of Nainital district's company-owned garages had no system. Almoradistrict's local garages had seventy-five per cent of them.

According to **Aprekoet *al.*(2015)** the usage of Personal Protective Equipment (PPE) among local automotive artisans in Ghana. The majority of artisans understand the need for PPE for protection against accidents, injuries, and illness. However, most do not wear PPE due to availability issues and discomfort.

Table 3.: Use of Fire Protective Equipment

		Nainital (n_1=4)		**Almora(n_2=8)**		**UdhamSinghNagar (n_3=2)**		**Total (n=14)**	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
1.	Fire alarm system	75 %	25 %	25 %	75%	100%	-	21.42 %	78.57 %
2.	Fire extinguisher	75 %	25 %	25 %	75%	100%	-	50%	50%

3.1.3 Medical services and first aid

According to Table 4, all authorized garages in Udham Singh Nagar were equipped with a hospital, a nearby clinic for medical care, first-aid supplies, and flushing facilities. But only 50% of these garages have a sign with an emergency phone number. The hospital and a local medical clinic were cent per cent accessible from company-owned garages, but none of the fifty per cent, seventy-five per cent, or cent per cent of these garages had first-aid supplies, toilets, or emergency phone numbers. Local garages in the Almora district claimed the presence of a hospital and a clinic, but no emergency phone numbers, first-aid supplies, or toilets.

Table 4: Medical services and first aid

		Nainital(n_1=4)		Almora(n_2=8)		UdhamSinghNagar(n_3=2)		Total(n=14)	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
1	Is there a hospital or clinic for Medicare health care in the vicinity of your workplace?	100 %	-	100 %	-	100%	-	100%	-
2.	Are first-aid kits availabl e?	50 %	50 %	12.5 %	87.5 %	100%	-	50%	50%
3.	Are emerge ncy phone number s posted?	-	100 %	-	100 %	50%	50%	7.142 %	92.85 %
4.	Are means provided for flushing the eyes and body in areas	25 %	75 %	37.5 %	62.5 %	100%	-	42.85 %	57.14 %

	where corrosive liquids or materials are handled?								

3.1.4 General work environment

Table 5 reveals that there were no clean, sanitary, and orderly facilities in the authorized garages of Udham Singh Nagar (50%), Nainital district (50%), and Almora district (62.5%). Additionally, slip-resistant facilities were not present in any of these garages. Paint spray booths and dip tanks were not regularly cleaned in any of the authorized garages, company-owned garages, or local shops. Additionally, there were no minimum numbers of toilets and washing facilities in any of the authorized garages, company-owned garages, or local shops. Overall, there were no clean and sanitary toilets or washing facilities in all garages.

Table 5: General work environment

		Nainital(n_1=4)		**Almora(n_2=8)**		**UdhamSinghNagar(n_3=2)**		**Total(n=14)**	
		yes	**no**	**Yes**	**no**	**yes**	**no**	**Yes**	**no**
1.	Are all worksites clean, sanitary, and orderly	50%	50%	37.5%	62.5%	50%	50%	42.85 %	57.14 %
2.	Are work surfaces kept dry or appropriate means taken to assure the surfaces are slip-resistant?	75%	25%	25%	75%	50%	50%	42.85 %	57.14 %
3.	Are our paint spray booths, dip tanks, etc cleaned regularly?	-	100%	-	100%	50%	50%	7.14%	92.85 %
4.	Are the minimum number of toilets and washing facilities provided?	100%	-	-	100%	100%	-	42.85 %	57.14 %
5.	Are all toilets and washing facilities clean and sanitary?	-	100%	-	100%	50%	50%	7.14%	92.85 %

3.2 Workplace assessment

Workplace assessment was done by implementing a workplace checkliststhat was practically designed and easy to implement for improving safety, health, and working conditions.

3.2.1 Material Handling

Table 6 shows that clear and marked transport ways are needed in authorized garages in Udham Singh Nagar (50%), company-owned garages in Nainital district (25%), and local shops in Almora district (100%). Multi-level racks for materials, tools, and products are needed in the Nainital district (75%), and local shops (87.5%). Carts, hand trucks, and mobile racks are also needed for moving materials. Instead of carrying heavy weights, they should be divided into smaller, lightweight packages, containers, or trays. Lifting devices or lift trucks are used for lifting heavy materials in the Nainital district (50%), and good grips or holding points are provided for containers and packages in both company-owned and local shops (100%).

3.2.2 Workstations

Table 6 shows that there is a need for planning actions to adjust the working height at elbow level, use foot platforms for small workers, and use work item holders for tall workers in some authorized garages in Udham Singh Nagar, company-owned garages in Nainital district, and local shops in Almora district. Frequently used materials should be placed in small containers within easy reach of the normal working position. Hanging tools or easily fixed tools for repeated operations should be used in some authorized garages. Standing workers should be provided with chairs or stools for occasional sitting, chairs of the correct height and good backrests, and labels and colours to avoid mistakes. A work-rotation system should be introduced to avoid the repetition of the same types of work in some authorized garages and local shops.

3.2.3 Teamwork Environment

Table 6 shows that there is a need for planning actions to provide sufficient lighting for workers in company-owned garages and local shops in Nainital district and Almora district. This includes repositioning lights or task lights for precision work, attaching proper guards or interlocking devices to avoid contact with moving machine parts, using safety devices to prevent machine operations while workers' hands are in danger, labelling containers of hazardous chemicals, ensuring safe wiring connections for equipment, clearly designating and marking areas requiring protective equipment, providing rest corners with comfortable facilities and refreshing drinks, providing first-aid equipment near the workplace, training a qualified first-aider, providing opportunities for short breaks for repetitive or arduous work, and rearranging the layout and order of operations to improve production flow. These measures are crucial for ensuring a safe and efficient work environment for all employees**.**

Table 6: Assessment of the Workplace

S.No	Statements	Nainital(n_1=4)	Almora (n_2=8)	Udham Singh Nagar(n3 = 2)	Total (n=14)
		Percentage	Percentage	Percentage	Percentage
	Material Handling				

1.	Clear and mark transport routes.	25	100	50	71.42
2.	Provide multi-level racks near the work area for materials, tools, and products.	75	87.5	-	71.42
3.	Use carts, hand trucks, and mobile racks when moving materials.	100	100	-	85.71
4.	Instead of carrying heavy weights, divide them into smaller lightweight packages and containers or trays.	100	100	50	92.85
5.	Use lifting devices or lift trucks for lifting heavy materials	50	100	-	71.42
6.	Provide good grips or holding points for all containers and packages.	75	100	-	78.57
	Workstation				
7.	Adjust the working height at the elbow.	100	100	100	100

	level (if necessary, use foot platforms for small workers and work item holders for tall workers).				
8.	Put frequently used materials in small containers placed within easy reach from normal working position.	75	100	-	78.57
9.	Use hanging tools or conveniently fixed tools for operations repeated at the same place.	100	100	100	100
10.	Provide standing workers with conveniently placed chairs or stools. for occasional sitting.	75	100	100	92.85
11.	Provide chairs of the correct height. (with both feet flatly placed on the floor) and with a good backrest.	75	100	100	92.85
12.	Attach simply worded labels and use colours to avoid mistakes.	100	100	50	92.85
13.	Introduce a work-rotation system to Avoid repetition of the same type. of work	100	100	100	100
	Teamwork environment				

14.	Provide sufficient lighting for workers by repositioning lights or providing task lights for precision. work.	75	100	-	78.57
15.	Attach proper guards or interlocking devices to avoid contact with moving parts of machines	25	100	-	64.28
16.	Use safety devices that prevent the operations of machines while the Workers' hands are in danger.	100	100	50	92.85
17.	Label containers of hazardous chemicals and store them in appropriate places.	100	100	100	100
18.	Ensure safe wiring connections for supplying electricity to equipment.	50	100	50	78.57
19.	Designate and mark areas. requiring the use of protective equipment, and making sure everyone uses it there.	100	100	50	92.85
20.	Provide rest areas with comfortable facilities, and refreshing drinks.	25	100	50	71.42

21.	Provide first-aid equipment near the workplace and train a qualified first-aider.	75	100	-	78.57
22.	Provide opportunities to take short breaks for repetitive or arduous work.	75	100	-	78.57
23.	Rearrange the layout and the order of operations to improve production. flow.	75	100	-	78.57

Conclusion

The study found that garages in Udham Singh Nagar provide centper cent of personal protective equipment (PPE) to their workers, while those in Nainital and Almora districts lack proper facilities. Udham Singh Nagar has a fire alarm system and extinguisher, while Nainital and Almora districts lack them. Additionally, a small percentage of garages lack emergency phone numbers for their workers. Nearly half of Udham Singh Nagar garage workers lack worksite cleaning facilities, slip-resistant floors, spray booths, dip tanks, and clean toilet facilities, while Nainital and Almora districts lack these facilities. and a quarter of garages in Udham Singh Nagar, Nainital, and Almora districts require adjustments to work height, foot platforms, work item holders, work-rotation systems, hanging toolboxes, and labelling hazardous chemical containers. These measures aim to prevent repetition and ensure safety in the workplace.

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