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Perception of occupational risk among automobile and motorcycle mechanics: a study in the informal sector of the Municipality of Baranoa (Atlantico, Colombia).

Percepción del riesgo laboral en mecánicos de automóviles y motocicletas: un estudio en el sector informal del Municipio de Baranoa (Atlantico, Colombia).

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Abstract

The perception of occupational risk was analyzed among automobile and motorcycle mechanics working in the informal sector of the municipality of Baranoa (Atlántico, Colombia). This observational, descriptive, and cross-sectional study (n = 33) was conducted during the first semester of 2025. A Likert-scale questionnaire (1–5) was applied, adapted from González (2015), consisting of 30 items across four dimensions: Risk knowledge (1–6), Workplace conditions (7–12), Safety practices (13–18), and Perceptions/attitudes (19–30). Mean scores were calculated for each dimension and overall. Reliability was adequate (overall α = 0.80; dimension α = 0.81–0.85). The overall mean score was 3.85 (SD = 0.46). By dimension: Risk knowledge = 4.05; Safety practices = 3.96; Workplace conditions = 3.84; Perceptions/attitudes = 3.70. Operational indicators: 72.7% reported receiving risk training; 63.6% reported use of PPE; 87.9% reported tool inspections; 48.5% perceived their trade as a health risk; and 36.4% reported stress due to working conditions. Internal consistency supported the reliability of the instrument. Findings revealed a moderate-to-high perception of occupational risk and basic preventive behaviors, with a gap between declared knowledge and personal risk assessment. The normalization of risk in informal contexts suggests the need to prioritize feasible and culturally appropriate control measures.

Palabras clave: Occupational risk, Informal mechanics, Popular economy, Occupational health.

Resumen

Se analizo la percepción del riesgo laboral en mecánicos de automóviles y motocicletas del sector informal del municipio de Baranoa (Atlántico, Colombia). El estudio es observacional, descriptivo y transversal (n = 33) realizado en el primer semestre de 2025. Se aplicó un cuestionario Likert (1–5) basado en la investigación de González (2015) de 30 ítems en cuatro dimensiones: Conocimiento de riesgos (1–6), Condiciones del puesto (7–12), Prácticas de seguridad (13–18) y Percepción/actitudes (19–30). Se calcularon promedios por dimensión y global. La confiabilidad fue adecuada (α global = 0,80; α por dimensión = 0,81–0,85). La puntuación global promedio fue 3,85 (DE = 0,46). Por dimensión: Conocimiento de riesgos = 4,05; Prácticas de seguridad = 3,96; Condiciones del puesto = 3,84; Percepción/actitudes = 3,70. Indicadores operativos: 72,7% reportó capacitación en riesgos; 63,6% uso de EPP; 87,9% revisión de herramientas; 48,5% percibió que su oficio representa riesgo para la salud; 36,4% refirió estrés por condiciones laborales. La consistencia interna respaldó la fiabilidad del instrumento. Se observó una percepción moderada-alta del riesgo y conductas preventivas básicas, con brecha entre conocimiento declarado y evaluación del riesgo personal. La normalización del riesgo en contextos informales sugiere priorizar controles factibles y culturalmente pertinentes.

Keywords: Riesgo ocupacional, Mecánicos informales, Economía popular, Salud laboral.

Introduction

The repair and maintenance of automobiles and motorcycles encompasses a broad range of occupational chemical, physical, ergonomic, mechanical, and psychosocial exposures that, if not properly managed, increase the likelihood of injuries, illnesses, and acute events. In this context, workers' risk perception plays a decisive role, as it influences both the adoption of preventive behaviors and the acceptance or rejection of control measures. Recent evidence shows associations between risk perception, safety motivation, and accident outcomes in various work contexts (Díaz & Sagastume, 2020; Jiménez & Acuña, 2023; Rodríguez, 2019; Valencia & García, 2021). Furthermore, work organization and safety practices influence preventive performance (Beltrán Molina et al., 2015; Salcedo et al., 2021).

In Colombia, and especially in the Caribbean region, the vehicle repair sector is characterized by a high presence of small production units and informal workshops, with flexible employment dynamics and often without formal occupational health and safety management systems. The municipality of Baranoa (Atlántico) offers a representative case: economic activity linked to mobility and motorcycle maintenance has grown rapidly, while institutional mechanisms for prevention training and supervision have advanced more slowly. This asymmetry creates vulnerable scenarios where work organization, availability of PPE, ventilation, and housekeeping practices may be insufficient or intermittent, a phenomenon frequently observed in micro and small businesses and related sectors (Cáceres et al., 2021; Jiménez & Acuña, 2023; Ortega et al., 2024; Salcedo et al., 2021; Loor, 2025).

Typical hazards in these occupations include exposure to hydrocarbons, solvents, used oils, combustion fumes and brake dust (with the potential for the presence of metals and fine particles), impact and continuous noise, hand-arm and whole-body vibration, radiant and microenvironmental heat, awkward postures, squatting or working

in confined spaces, manual handling of loads, and repetitive movements; in addition to mechanical risks (entrapment, cuts, projections) and eye and skin injuries. Recent evidence summarizes that non-exhaust emissions (such as brake wear) contribute substantially to the particulate burden (Grigoratos & Martini, 2015); that in jobs with high biomechanical demand, there remains a high risk of musculoskeletal disorders (Cáceres et al., 2021; Mendinueta-Martínez et al., 2017); and that in automotive maintenance environments, conditions converge that demand comprehensive interventions on safety practices and resources (Beltrán Molina et al., 2015; Salcedo et al., 2021).

From a theoretical perspective, risk perception integrates cognitive (knowledge, probability and severity estimation), affective (fear, trust, habituation), sociocultural (trade standards, peer pressure, image of the "skilled worker" who assumes risks), and organizational (leadership, incentives, availability of PPE and appropriate tools) dimensions. In artisanal or empirically based trades, the normalization of deviation is common: practices that, despite being unsafe, are consolidated as standard through accumulated experience without immediate serious events, reinforcing illusions of control and perceptual biases. Recent studies in working populations have documented these patterns and their relationship with safe behaviors (Díaz & Sagastume, 2020; Rodríguez, 2019; Valencia & García, 2021) and safety outcomes (Jiménez & Acuña, 2023).

While international evidence on risks in the formal automotive sector exists, studies focused on the informal sector, and specifically on motorcycle and car mechanics in intermediate municipalities in the Colombian Caribbean, are scarce. This gap makes it difficult to design culturally relevant and low-cost interventions and limits coordination with national guidelines and continuous improvement frameworks adapted to the realities of micro-workshops, where the challenges of implementing preventive activities are well known (Cáceres et al., 2021; Ortega et al., 2024; Salcedo et al., 2021; Loor, 2025).

In this context, this study aims to analyze the perception of occupational risk among automobile and motorcycle mechanics in the informal sector of the municipality of Baranoa, identifying the hazards prioritized by workers, the factors associated with their perception (career history, prior training, reported preventive practices), and the barriers/facilitators for the adoption of control measures. The findings are expected to provide a local baseline to guide strategies for education, signage, order and cleanliness, replacement of supplies, improved ventilation, and availability/correct use of PPE, and to strengthen municipal initiatives and local technical support networks (Beltrán Molina et al., 2015; Salcedo et al., 2021).

Methodology

An observational, descriptive, cross-sectional study was conducted with 33 automobile and motorcycle mechanics in the municipality of Baranoa (Atlántico, Colombia) during the first half of 2025 (Setia, 2016). To determine the number of participants, convenience sampling was used with informal workers who were willing to participate and signed informed consent (Etikan et al., 2016).

The study used a five-point Likert-type questionnaire (1 = strongly disagree, 5 = strongly agree) to measure risk perception among informal sector mechanics. The instrument was structured based on González (2015) and included 30 items in four dimensions: Risk knowledge (items 1–6), Job conditions (items 7–12), Safety practices (items 13–18), and Perception/attitudes (items 19–30). Item construction and interpretation of higher scores as higher risk perception and greater agreement with preventive behaviors were informed by theoretical models of self-protective behavior and risk perception literature (e.g., DeJoy, 1994; Slovic, 1987), as well as by best practices in scale development/validation and use of Likert scales (Boateng et al., 2018; Chyung et al., 2017; Joshi et al., 2015). Scores per dimension were calculated as the average of its items, and the overall score was calculated as the average of the 30 items (scale 1–5). The internal consistency estimated in the Baranoa sample (n = 33) was adequate (Cronbach's α = 0.80–0.85), in accordance with current methodological criteria and recommendations (Cho & Kim, 2015; Taber, 2018; Trizano-Hermosilla & Alvarado, 2016; Viladrich et al., 2017).

Microsoft Excel was used to process the survey data. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the CIOMS Guidelines for Research Involving Human Subjects (World Medical Association, 2013; CIOMS, 2016). In Colombia, Resolution 008430 of 1993 classifies this type of study as

minimal risk, as it uses surveys without interventions that compromise the integrity of the participants (Colombian Ministry of Health, 1993).

Results and discussion

Thirty-three Likert-type surveys (1–5) administered to mechanics in the informal sector in Baranoa (Northern Colombia) were analyzed. The items were grouped into four dimensions: (a)Risk awareness(1–6), (b)Job conditions(7–12), (c)Safety practices(13–18) and (d)Perception/attitudes(19–30). Overall, the average overall score was3.85(SD=0.46), which indicates amoderate-high perceptionof risk and preventive practices in the sample.

In comparative terms shown in theTable 1,The highest-scoring dimension was Risk Awareness (M=4.05), suggesting that most individuals recognize potential accidents and know how to identify sources of danger. This was followed by Safety Practices (M=3.95), which highlighted preventive behaviors such as checking tools before use. Job Conditions scored an average of 3.84, with variability across lighting/ventilation, order, and comfort. Finally, Perception/Attitudes scored 3.70, reflecting a more nuanced assessment of personal risk, stress, and institutional support.

Table 1.

Means, standard deviations, and Cronbach's α.

Dimension	Items (n)	Media (1–5)	OF	Cronbach's α
Risk awareness (1–6)	6	4,045	0.814	0.826
Conditions of the position (7–12)	6	3,843	0.911	0.827
Safety Practices (13–18)	6	3,955	0.83	0.807
Perception/attitudes (19–30)	12	3,697	0.739	0.845
Overall score	30	3,847	0.456	0.8

Source: Own elaboration

At the item level, the highest averages were observed in: “Pride in the craft” (M≈4.61), “I would like to see more support programs for informal workers.” (M≈4.55), “I identify dangerous tools or materials” (M≈4.42) and “I know what accidents can happen in my job” (M≈4.33). Likewise, thewillingness to receive trainingwas elevated (87.9%agree/strongly agree). In contrast, the lowest scores corresponded to “I feel stressed about working conditions” (M≈3.00), “I believe my job poses a risk to my health.”(M≈3.15) and “My work is not valued or protected by the authorities”(M≈3.45), suggesting that theReported stress and personal risk perception are moderate, although they live with concern about accidents (60.6%reported that fear of an accident affects their peace of mind).

Relevant operational indicators:72.7% reported having receivedtrainingat risk;63.6%Indianuse of PPE;87.9%statedreview toolsbefore using them;48.5%agreed that his professionrepresents a health risk;and36.4%declared himselfstressedby current conditions (agree/strongly agree). Internal consistency by dimension wasadequate(α≈0.81–0.85) and that of the global instrument wasα≈0.80,which supports thereliability of the measurements in this sample.

The findings show a moderate-to-high risk perception among informal sector mechanics in Baranoa. Higher scores on risk knowledge and safety practices, in contrast to relatively lower scores on attitudes and perception, suggest that the population recognizes the dangers and engages in basic preventive behaviors, although they maintain reservations or ambivalence when assessing their own risk and the impact on their health (Valencia & García, 2021; Jiménez & Acuña, 2023).

This pattern is consistent with informal work settings where chronic exposure normalizes risk and preventive decisions are conditioned by resource constraints, time pressures, and a lack of institutional oversight; in such contexts, knowing how to identify hazards does not always translate into sustained behavioral changes when controls

entail costs, thermal discomfort, or interfere with skill, especially with variable incomes (Cáceres et al., 2021; Ortega et al., 2024; Díaz & Sagastume, 2020).

The stated practice of checking tools, attending training, and using PPE in a relevant proportion provides an operational basis on which to build feasible interventions. At the same time, the tasks inherent to automotive and motorcycle mechanics involve exposure to noise from tools and engine inspections, chemical agents present in degreasers, fuels, and paints (with possible diisocyanates), metal fumes and dust, potential lead depending on the age of the vehicle fleet, silica in grinding operations, in addition to biomechanical demands due to awkward postures and load handling, and psychosocial factors linked to long hours and variability in demand (Salcedo et al., 2021; Ortega et al., 2024; Grigoratos & Martini, 2015; Mendinueta-Martínez et al., 2017).

The reported stress appears to be moderate, which may reflect coping strategies and redefining the risk inherent to the job. However, a lower self-perception of personal risk does not imply an absence of psychosocial burden or physiological impact, so it is advisable to complement it with specific instruments and, when possible, with qualitative approaches that allow us to understand beliefs, motivations, and barriers to adopting control measures (Díaz & Sagastume, 2020; Rodríguez, 2019; Valencia & García, 2021).

The adequate internal consistency observed across dimensions and at the global level supports the instrument's reliability and lends robustness to comparisons across domains; however, limitations inherent to the cross-sectional design and self-reporting should be considered. The focus on Baranoa and the informal sector restricts generalization to formal workshops or other locations in the Atlantic. The lack of objective exposure measurements prevents accurate estimation of the magnitude of the risk; future assessments should integrate noise dosimetry, solvent/diisocyanate exposure matrices, postural analysis, and specific clinical screenings (Setia, 2016; Taber, 2018).

The practical implications point to a minimum control package with a high probability of adoption in the local context. Natural ventilation and shade, order and cleanliness with simple methodologies, preventive tool maintenance, and workday organization to mitigate heat peaks can reduce risks with limited investment. The selection and scheduled replacement of PPE based on thermal comfort criteria, along with periodic micro-training focused on critical tasks (improvised lockout/tagout, fuel and battery handling, safe lifting of motorcycles/vehicles, entrapment prevention, and solvent handling) would reinforce existing habits and close gaps between knowledge and action (Cáceres et al., 2021; Jiménez & Acuña, 2023; Salcedo et al., 2021).

At the institutional level, the informal nature of the work suggests collaborative strategies: local "safe workshop" programs with verification of microstandards and public recognition, agreements with suppliers for cross-subsidized protection kits, and traveling technical brigades with on-site demonstrations can favor the adoption of measures with low entry costs. The willingness to receive training observed in the sample is an opportunity to pilot short, recurring modules focused on priority risks such as noise, solvents, order and cleanliness, loads, and electricity (Rodríguez, 2019; Jiménez & Acuña, 2023).

Discussion

After the thorough review it was important to synthesize comprehensible the patterns that have emerged, also it is important to analyze and discuss the different key points that emerged across the literature.

Across the analyzed literature, there was a clear agreement about how immersive game-based classes design were fundamental at boosting motivation and engagement among students. For instance, Chen et al. (2021) reported higher language engagement when learners created and navigated VR content as part of the task structure. Additionally, the research positions VR as a vehicle for problem-based work, not as a

gadget in isolation that can function without clear pedagogical goals. In the same vein, Lin & Wang (2021) integrated a VR creative project ("hometown tours") and found increases in creative self-efficacy alongside intrinsic motivation, because the language production (script drafting, voice-over, revisions) is built into the VR workflow.

Nevertheless, Çelik & Yangın Ersanlı (2022) showed that AR-gamified CLIL can lift English learning achievement and attitudes, aligning with the general "playful plus content-embedded task" effect seen in the immersive studies. In the same vein, documents referencing game mechanics showed gains in engagement and formative interaction as long as the included technology is tied up to feedback cycles and well defined pedagogical objectives rather than a work-alone tool.

The presented results across the mentioned studies demonstrates that the inclusion of technological tools such as VR and AR have a positive impact on EFL classes. Furthermore, these tools promote the use of the language in creative and effective ways, nevertheless, teachers should consider certain aspects for its correct application. First and foremost, the use of technology is repeatedly mentioned that could not reach its full potential when it is used without the supervision and management of an instructor. Secondly, the inclusion of these tools did not necessarily demonstrate a considerably higher performance than traditional means. Lastly, technology and clear pedagogical goals must work together to show reliable outcomes which makes its implementation fully dependent on the instructor's experience, conceptions and tech-experience in order to fully take advantage of technology in EFL context.

Another area of agreement concerns speaking performance and affect when immersive practice is combined with structured feedback. Chien, Hwang & Jong (2020) found that SVVR practices improved oral performance, boosted motivation, and reduced speaking anxiety when paired with rubric-guided peer feedback. This resonates with the VR-as-task-space perspective above: it's the feedback design in the experience, not only the headset, that moves outcomes.

Notice that feedback has been a crucial part across every tech-inclusion mentioned thus making it important for EFL teachers to consider it as an inseparable part of the teaching process. In a more general review, the “pedagogical design over device” message was a recurring topic across literature. This perspective is also crucial as it stated that teachers' well-planned class and defined objectives are more important than the mere inclusion of technology.

Nevertheless, it was possible to find clear disagreement or divergences across the exposed studies. As a matter of fact, several of the analyzed documents underscores that VR and AR alone did not guarantee better educational outcomes. Lin & Wang (2021) called for adding direct measures of speaking and writing, and for non-immersive comparison conditions to produce stronger evidence. A key consideration for EFL instructors were the comparisons between VR vs print or non-VR as in the wider literature VR show only modest differences on standardized outcomes even when learners report high engagement. For instance, Chien et al. (2020) noticed that feedback design was a key component of improving while using VR. This further proved that immersion alone reduces anxiety and boosts performance; the study showed its immersion plus carefully designed peer assessment that matters.

It is important to note that relying solely on Scopus may omit regional or non-indexed EFL journals, and the citation threshold could exclude newly published yet significant studies. Additionally, selecting 37 studies highly constrains the scope of the review, making the present study open to future peer scrutiny.

The present review worked as a means of further analyzing a not widely covered topic as it is a comprehensive literature review. As stated beforehand, the scope of the presented study highly constrains the results of the investigation. Furthermore, one is conscious about the limited amount of technologies covered. Due to these limitations, it would be reasonable to understand this review as an analysis and comparison of a specific set of educational technologies. It fosters a holistic comprehension of the said

area and provides help to EFL instructors to improve their understanding on ways of implementing technologies in EFL contexts.

Peer researchers are exhorted to conduct a wider review on the topic as means of furthering the understanding on technology implementation in education and its positives and negatives points of its integration. Future research on the topic can be conducted as case studies in which the objective is to analyze and compare EFL classes with and without the inclusion of technology nevertheless, it should be presented considering different socio-cultural levels and demographics.

EFL instructors should consider technology as a crucial tool for the development of EFL education. However, traditional means of education (books, paper, pen and pencils) are not necessarily bad options for education. Technology offers a wide catalogue of tools and means for interactive learning but its full potential can only be achieved as a result of a well-designed academic planning. The same way as traditional tools require well-set pedagogical objectives, technology based-instruction also needs to be included into this planning when integrating it.

Conclusion

This study shows that, among automobile and motorcycle mechanics in the informal sector of Baranoa, occupational risk perception is at a moderately high level. The dimensions of hazard knowledge and preventive practices are notable, while attitudes and personal risk assessment are comparatively lower. The instrument's reliability was adequate, lending robustness to the inferences. Despite this, a gap persists between reported knowledge and the sustained implementation of controls, associated with the normalization of risk, resource limitations, and poor institutional oversight. Consequently, a minimum feasible and culturally relevant intervention package is proposed: natural ventilation and shade, systematic housekeeping, preventive tool maintenance, selection of comfortable personal protective equipment,

and micro-training focused on critical tasks such as fuel and solvent handling, safe vehicle lifting, and entrapment prevention. Municipal partnerships for waste management and the promotion of local industrial safety programs with simple verification and public recognition are recommended. Limitations include the cross-sectional design, convenience sampling, self-reporting, and the lack of objective measurements. Future studies should incorporate longitudinal follow-up and evaluate low-cost interventions with objective indicators of exposure and health.

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