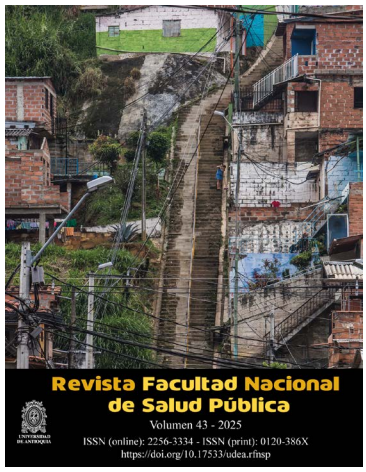

Title: Escaleras
Author: Juan Fernando Ospina - Fotógrafo
Medellín

Ergonomics and Public Health: Creating Healthy and Safe Work Environments

Yordán Rodríguez[1]

[1] PhD in Ergonomics. Full Professor and Senior Researcher. National School of Public Health, University of Antioquia. Certified Professional Ergonomist by the United States Ergonomics Professional Certification Board. yordan.rodriguez@udea.edu.co. Editor of the special *Ergonomics and public health* issue

Introduction

This special issue on ergonomics and health marks an important milestone, as it is the first issue in a Spanish-language scientific journal to link these two scientific disciplines. Furthermore, this special issue, comprised of thirteen articles, is part of the celebrations for the 50th anniversary of the *Revista Facultad Nacional de Salud Pública* of the Universidad de Antioquia.

This issue consolidated the contributions of 40 researchers from Chile, Colombia, and Mexico, the vast majority holding various postgraduate degrees, reflecting the high academic standing of the participating authors. Furthermore, there was a strong representation of renowned Latin American institutions (see Table 1).

Table 1. Institutions represented in this special issue

Institution	Country of origin
Mutual de Seguridad Chilean Chamber of Construction	Chili
University of Atacama	
Méderi University Hospital	Colombia
Antonio José Camacho University Institution	
Metropolitan Technological Institute	
University of Antioquia	
University of Rosario	
University of Valle	
Industrial University of Santander	
Simón Bolívar University	
National Technological Institute of Mexico	Mexico
Autonomous University of Baja California	
Autonomous University of Ciudad Juárez	
University of Guadalajara	
National Autonomous University of Mexico	

Volume 43, 2025
DOI: https://doi.org/10.17533/udea.rfnsp.358206

Received: 11/08/2025
Approved: 12/08/2025
Published: 13/08/2025
English version: 31/08/2025

Cite:
Rodríguez Y. Ergonomics and Public Health: Creating Healthy and Safe Work Environments. Rev. Fac. Nac. Salud Pública. 2024;42:358206
DOI: https://doi.org/10.17533/udea.rfnsp.358206

The purpose of this special issue is to illustrate how the discipline of ergonomics, from its holistic/systemic and human-centered perspective, can contribute to the creation of healthy and safe work environments and systems, and to the strengthening of public health.

Ergonomics: a scientific discipline that contributes to public health

Ergonomics and public health are scientific disciplines that use a systemic perspective to solve problems that impact the health and well-being of people, and both are developed in a significant number of areas (see Table 2).

Table 2. Examples of areas of application and development of the disciplines of ergonomics and public health

Ergonomics	Public health
Affective ergonomics	Health administration and management
Cognitive ergonomics	Biostatistics
Community ergonomics	Social determinants of health
Information ergonomics	Emergencies and disasters
Rehabilitation ergonomics	Chronic diseases
Ergonomics of knowledge	Infectious diseases
Consumer ergonomics	Epidemiology
Ergonomics of aging	Nutrition in public health
Ecological ergonomics	Health policies
Physical ergonomics	Health promotion
Forensic ergonomics	Environmental health
Participatory ergonomics	Global health
Human-system integration	Maternal and child health
Human-computer interaction	Mental health
Macroergonomics	Occupational health
Nanoergonomics	Food safety
Neuroergonomics	Health information systems

Like public health, ergonomics is recognized as a scientific discipline and a well-established profession [1-3] and is defined by the International Ergonomics Association as "The scientific discipline that deals with the study of interactions between people and other elements of a system and the profession that applies theory, principles, information and methods to optimize human well-being and overall system performance" [4; our translation].

This definition highlights the two main outcomes expected from the application and integration of ergonomics in work environments: human well-being (e.g., health, safety, satisfaction, pleasure, personal development) and improved system performance (e.g., productivity, efficiency, effectiveness, quality, innovation, reliability, and sustainability of systems), which are interrelated.

In the complex framework of public health, ergonomics emerges as an essential discipline for harmonizing living and working conditions with people's capabilities, limitations, and aspirations. To achieve this, physical, cognitive, social, cultural, organizational, and environmental factors, among others, must be considered [2, 5].

Thus, ergonomics can help improve several aspects of people's living and working environments, such as: the design of workstations and shifts; fatigue management; prevention of occupational diseases (e.g., musculoskeletal disorders); anthropometric design of tools, equipment, access points, areas, and buildings; assessment and design of environmental conditions (e.g., cold, heat, noise, lighting); prevention of medication errors, incidents, accidents, and adverse events; design of decision-making aids; design of the graphical interface of equipment and teleworking; evaluation of the usability of equipment and devices; optimization of production and service processes; effectiveness of communication and teamwork; participatory design; improvement of telemedicine assistance; workplace inclusion; design of software interfaces *and* virtual platforms; surgical procedures; risk communication; integration of human-

centered artificial intelligence technologies; error detection; mental workload; cooperative work, the design of personal protective equipment, etc.

Research in ergonomics from a health perspective

Research and the application of ergonomics from a health perspective has the potential to build a healthier and more sustainable future for all, as it broadens the scope of potential impacts that can be achieved at the population and global levels.

This was one of the challenges we had to work diligently on during the editorial process. Based on my experience, I believe that professionals dedicated to the application and research of ergonomics often fail to adequately assess the impact of our actions at the population level. Perhaps this is because, primarily, our ergonomic evaluation and intervention projects are limited to improving the interaction between a small group of people and specific elements of the sociotechnical system of interest (e.g., tasks, technologies, environmental conditions, tools, work organization, workload, biomechanical interaction). In this sense, ergonomists and related professionals must incorporate a health-related approach into our work and project the impact of our actions beyond a specific object of study.

The articles in this special issue cover a wide variety of topics from different sectors. They clearly demonstrate the contributions that ergonomics can make to public health.

Three of the investigations published in this issue are directly related to the analysis of musculoskeletal disorders (MSD), one of the occupational diseases with the greatest social and economic impact. Mendinueta *et al.* evaluated the relationship between the perception of the ergonomic climate in the company and the presence of musculoskeletal discomfort in 1339 workers from three Colombian cities [6]. Astudillo *et al.* carried out an analysis of the frequency of cases of occupational musculoskeletal disorders in the upper extremities in Chile over 10 years (2009-2019). In addition, the level of compliance with Chilean ergonomics regulations to address these occupational diseases was evaluated, as well as their differentiated impacts by gender [7]. For its part, the study by Villanueva *et al.* Regarding the DME , was carried out in 15 Chilean micro and small companies, in which the prevalence of symptoms of musculoskeletal disorders reported by workers, the types of occupational exposure and ergonomic conditions were analyzed. The results showed a high prevalence of musculoskeletal disorders among workers and the urgent need to carry out ergonomic interventions in repetitive tasks and manual handling of loads, taking into account that these may be limited by the existing labor informality and the lack of public health policies in the sector studied [8].

Three other investigations were redirected from the perspective of occupational biomechanics and carried out in laboratory settings. The first, by Campoya *et al.* focused on measuring hand grip strength in 30 people, recreating several experimental laboratory conditions, taking into account different levels of physical and mental demands, as well as the order and timing of tasks. This study provides valuable information for ergonomic analysis and design, since grip strength is an important variable in the design of tools and devices used in work and daily life environments [9]. In the research by Pacheco *et al.,* a methodology was developed to evaluate manual strength, investigating the differences and correlations between both hands and between genders in 382 people. The results showed uniformity in grip strength between both hands, greater torque in the right hand, and variations based on gender, highlighting the importance of taking these differences into account in the design of ergonomic interventions and occupational safety protocols [10]. Finally, the third investigation, by Herrera-Espitia *et al.* , focused on analyzing the presence and absence of electromyographic silence in 10 workers performing maintenance and general services tasks while performing unloaded forward trunk flexion [11]. The methodology used in this study could be replicated in other economic sectors, such as health, agriculture and transport, to improve the early detection of lumbar injuries, given the potential advantages offered by the use of surface electromyography as a rapid and non-invasive tool to assess the predisposition to chronic low back pain [11].

An important step in improving the health and well-being of people in companies is the return to work process. Martínez-Álvarez *et al.* explored the perceptions of a group of workers who had returned to work after suffering health problems [12]. The results revealed that workers experience pain and restrictions in their tasks, perceive a lack of appropriateness in the distribution of these tasks, and feel that their work environment does not consider their capabilities, which leads to poor integration. The authors suggest the implementation of participatory and comprehensive ergonomic interventions to improve the return to work process [12].

This special issue also includes three investigations oriented to the design of devices and tools that take ergonomic principles as a reference. The first, by Rojas *et al.* , was developed in the military sector, with the purpose of proposing the design of a structural grid for military backpacks/rucksacks that, according to estimates, is projected to help reduce the compression force on the L4/L5 intervertebral discs and improve back posture according to simulations [13]. In the second, Rodríguez-García *et al.* focus on the ergonomic design of a tool for transporting cocoa pods in agriculture. It is

estimated that this new tool reduces the force on the erector spinae muscle of the back by 19% compared to traditional transport, which may be beneficial for cocoa farmers in the region. Additionally, the authors of this work point out the need to continue improving the design of the tool, given that there are aspects that could not be optimized (e.g. back flexion) [14] . In the third investigation, developed by Mantilla and García, a co-design methodology was presented to develop an agricultural hand tool, involving 143 farmers so that their needs and desires were considered from the product conception. The results showed that the new tool, a dual-purpose hoe, improved ergonomic quality, by reducing postural risk and increasing perceived comfort, highlighting the importance of involving users in the early stages of technological development [15] .

The strengthening and development of public health in any country depends, to a large extent, on the improvement of its health systems. This special issue includes two research papers that address relevant topics within the healthcare sector from the perspective of ergonomics. The first research, by Meza-Galindo *et al.* , focuses on improving patient safety [16], an area where ergonomics has made important contributions [17-19]. In this context, the authors [16] explain how the renowned systems engineering model for patient safety (SEIPS) allows the analysis of foreign objects retained in surgery, highlighting failures in processes, such as the surgical count performed by nursing staff [16] . They also highlight how, by analyzing the interaction of the key components of the SEIPS MODEL (people, tasks, tools, environment and organization), it is possible to generate actions aimed at preventing these safety incidents [16] . The second investigation, carried out by Perdomo and Murcia, focuses on the evaluation of biomechanical risk with the Movement and Assistance method. of Hospital Patients (MAPO) of manual patient handling activities performed by nursing staff in two hospitals in Bogotá, Colombia [20]. In this study, high risk levels were found in almost all areas studied and the need to implement and maintain intervention strategies and ongoing training to reduce these risks is highlighted, especially in situations where patients are not able to fully cooperate [20].

Among the wide variety of topics addressed in this special issue, the validation of the domain of workplace violence in the automotive industry in Mexico is included, using the instrument proposed in the Mexican standard NOM -035-STPS -2018 for the evaluation of psychosocial factors at work [21]. The study by Gutiérrez-Hernández *et al.* showed a high reliability of the instrument according to the calculated indices and a good fit according to the modeling with structural equations. The results indicate that of the 250 participating supervisors, 59% are at high psychosocial risk, highlighting the need to address this problem from a macroergonomic approach , which today is an important concern for public health [21] .

The aforementioned studies constitute a significant reference for improving the living and working conditions of people in any sociotechnical system from an ergonomics perspective. Furthermore, the results and analyses conducted are a valuable source of scientific evidence for developing strategies aimed at improving the public health of Latin American populations.

Strategies for integrating ergonomics into Latin American society

The research and applications contained in this special issue demonstrate the rise and broad scope of ergonomics in the region, as well as the concrete contributions it can make to public health, viewed through the lens of ergonomics. However, I believe there are several strategies that should be implemented in the Latin American context to multiply these contributions, thus broadening the impact of ergonomics on public health and society in general.

- *Include ergonomics as part of public health policies* . It is essential that ergonomists demonstrate the value of ergonomics in solving social and public health problems. Unfortunately, the narrow view of the field of ergonomics held by many key stakeholders significantly limits the inclusion of this discipline in public policies. For example, in Colombia, the Ten-Year Public Health Plan, which defines the objectives, goals, and strategies to address public health challenges over the next 10 years (2022–2031), does not include ergonomics as a means of improving the quality of life and work of the Colombian population [22]. This is clear evidence that much work remains to be done to materialize this strategy. This special issue is one grain of sand among many needed to achieve this goal.
- *Integrate ergonomics into healthcare systems at all levels* . For some time now, researchers [17-19] and institutions in the health field, such as the World Health Organization (WHO) [23] and the National Health Service in England [24], have promoted and explicitly raise the need to incorporate the ergonomics approach in the health sector. This incorporation, at different micro, meso and macro levels, would contribute to improving the safety and well-being of patients and their families, the work of health professionals, as well as the quality and efficiency of health services [17-19].
- *Expand and strengthen the academic offering for studying ergonomics* . To carry out a process of transformation in work environments and human activity at a social level, it is essential to increase the number of ergonomics

professionals. In this regard, the training of ergonomics researchers and specialists is a fundamental step toward achieving large-scale transformation. In line with the above, the study of this knowledge and discipline should be included in the curricula of various professions, just as the WHO proposed its inclusion for health professionals several years ago [25].

- *Establish laws that require the incorporation of ergonomic principles and approaches into production and service processes* . Despite the seemingly obvious benefits that the application of ergonomics would bring, in global terms, we are only taking the first steps in a long marathon.
- A key strategy for influencing the processes of public and private organizations is the development of a mandatory regulatory framework that draws on the latest scientific and technical advances and contextualizes them to our realities. Currently, there are a significant number of international ergonomics standards in diverse areas that serve primarily as technical references (e.g., the International Organization for Standardization standards). However, their compliance is not mandatory in most countries around the world. In Latin America, to date, in countries where ergonomics is included in the mandatory legal framework, it has been restricted to topics related to the prevention of musculoskeletal diseases. This is undoubtedly a step forward, but it falls far short of harnessing the true potential of this profession and scientific discipline to generate social well-being and health.
- *Promote and support the development of ergonomics research* . It is no surprise that, in general, many of the approaches, technologies, methods, and tools we use in Latin American countries, including those reported in this special issue, originate in developed countries. Although of undoubted value, practice has shown that we must rely on our own developments, tailored to our contexts. In this sense, indigenous research is an essential path to achieving this goal and, accordingly, should be supported with resources by governments and institutions interested in the well-being and health of the population.

One swallow does not make a summer. Therefore, the implementation of these strategies must be conceived in an articulate, systemic, and simultaneous manner. I am optimistic, and I hope that in the future, when another special issue similar to this one is compiled, many of these actions will have been partially or fully implemented. By then, human interaction with their environment will have probably transformed, and other strategies will likely be needed. Time, as always, will tell the final word.

Acknowledgments

I would like to thank the 40 authors who contributed their research to this special issue, and the reviewers for their input during the editorial process. I also want to express my gratitude for their support and highlight the professionalism of the journal's entire editorial team.

References

1. Karwowski W. Ergonomics and human factors: The paradigms for science, engineering, design, technology and management of human-compatible systems. Ergonomics. 2005;48(5):436-63. DOI: https://doi.org/10.1080/00140130400029167
2. Dul J, Bruder R, Buckle P, et al. A strategy for human factors/ergonomics: Developing the discipline and profession. Ergonomics. 2012;55(4):377-95. DOI: https://doi.org/10.1080/00140139.2012.661087
3. Torres Y, Rodríguez Y. Emergence and evolution of ergonomics as a discipline: reflections on the human factors school and the activity ergonomics school. Rev. Fac. Nac. Salud Pública. 2021;39(2):1-9. DOI: https://doi.org/10.17533/udea.rfnsp.e342868
4. International Ergonomics Association (IEA). IEA Publications. [Internet]. 2023 [cited Mar 2023 21]. Available at: https://iea.cc/publication/
5. Hendrick HW. The technology of ergonomics. Theoretical Issues in Ergonomics Science. 2000;1(1):22-33. DOI: https://doi.org/10.1080/146392200308453
6. Mendinueta M, Herazo A, Palacio E, Polo R, Roa E, Casseres M. Perception of the company's ergonomic climate and the presence of musculoskeletal discomfort in workers Rev. Fac. Nac. Public Health. 2024;42:e356001. DOI: https://doi.org/10.17533/udea.rfnsp.e356001.
7. Astudillo P, Ibarra C, Ramos M, Aguilera F, Ramos S. Regulations on ergonomics and occupational musculoskeletal disorders of the upper extremities in Chile (2009-2019): impacts by gender. Rev. Fac. Nac. Salud Pública [internet] 2024 [cited 2024 Jul. 12]; 42:e355915. DOI: https://doi.org/10.17533/udea.rfnsp.e355915
8. Villanueva CI, Astudillo PA, Pison MJR, Olivares FA. Ergonomic diagnosis of the risk of musculoskeletal disorders in workers in micro and small businesses. An exploratory study. Rev. Fac. Nac. Salud Pública. 2024;42: e355915 . DOI: https://doi.org/10.17533/udea.rfnsp.e357074
9. Campoya A, Hernández J, Maldonado A, González E, Muñoz P. Analysis of handgrip strength under different physical and mental conditions as a public health strategy. Rev. Fac. Nac. Salud Pública. 2024;42:e356229. DOI: https://doi.org/10.17533/udea.rfnsp.e356229
10. Pacheco M, Hernández J, Aguilar J. Manual strength assessment: implications for public health and occupational injury prevention. Rev. Fac. Nac. Salud Pública. 2024;42:e355563 DOI: https://doi.org/10.17533/udea.rfnsp.e355563

11. Herrera-Espitia S, Olaya-Mira N, Soto-Cardona I, Osorio-Vasco J. Biomechanical analysis of the lumbar area using surface electromyography: Flexion–relaxation ratio in maintenance workers. Rev. Fac. Nac. Public Health. 2024;42:e356473. DOI: https://doi.org/10.17533/udea.rfnsp.e356473

12. Martínez-Álvarez L, Galarza-Iglesias A, Zapata-Albán M. Reinstated workers' perceptions of job integration. Rev. Fac. Nac. Public Health. 2024;42:e355871. DOI: https://doi.org/10.17533/udea.rfnsp.e355871

13. Rojas V, Maradei F, Santos A, Rivera C. Ergonomic backpacks: a mesh net to reduce load and posture risks. Rev. Fac. Nac. Public Health. 2024;42:e355982. DOI: https://doi.org/10.17533/udea.rfnsp.e355982.

14. Rodríguez-García J, Domínguez S, García FM. CAOTERO: a tool for transporting cocoa and its ergonomic evaluation. Rev. Fac. Nac. Public Health. 2024;42: e355982 . DOI: https://doi.org/10.17533/udea.rfnsp.e355972

15. Mantilla S, García FM. Ergonomic methodology for the technological development of a hand-held agricultural tool: a case study of a hoe. Rev. Fac. Nac. Public Health. 2024;42: e355982 . DOI: https://doi.org/10.17533/udea.rfnsp.e355971

16. Meza-Galindo M, Ensaldo-Carrasco E, Aceves-González C. Ergonomics and human factors in public health: a perspective for understanding the relationship between retained foreign objects and nursing staff. Rev. Fac. Nac. Salud Pública. 2024;42:e355794. DOI: https://doi.org/10.17533/udea.rfnsp.e355794

17. Aceves-González C, Rodríguez Y, Escobar-Galindo CM, et al. Frontiers in human factors: Integrating human factors and ergonomics to improve safety and quality in Latin American healthcare systems. Int J Qual Health Care. 2021;33(Supplement 1):45-50. DOI: https://doi.org/10.1093/intqhc/mzaa135

18. Hignett S, Carayon P, et al. State of science: Human factors and ergonomics in healthcare. Ergonomics. 2013;56(10):1491-503. DOI: https://doi.org/10.1080/00140139.2013.822932

19. Rodríguez Y, Hignett S. Integration of human factors/ergonomics in healthcare systems: A giant leap in safety as a key strategy during COVID-19. Hum Factors Ergon Manuf. 2021;31(5):570-6. https://doi.org/10.1002/hfm.20907

20. Perdomo-Hernández M, Murcia-Soriano LF. Risk assessment associated with manual patient handling among nursing staff in a hospital network in Colombia. Rev. Fac. Nac. Salud Pública. 2024;42:e355138. DOI: https://doi.org/10.17533/udea.rfnsp.e355138

21. Gutiérrez-Hernández M, Maldonado-Macías A, Jara H, Hernández J, Barajas-Bustillos M. Psychosocial factors assessment for the Mexican standard 035: A validation of the domain of workplace violence in the automotive industry. Rev. Fac. Nac. Salud Pública. 2024;42:e356557. DOI: https://doi.org/10.17533/udea.rfnsp.e356557

22. Colombia, Ministry of Health and Social Protection. Resolution 1035 of 2022. By which the Ten-Year Public Health Plan 2022-2031 is adopted with its different chapters: indigenous for the indigenous peoples and communities of Colombia, population victims of armed conflict, the Rrom People and the Black, Afro-Colombian, Raizal and Palenquera population [internet]. 2022 Jun. 14 [cited 2024 Aug. 23]. Available at: https://www.minsalud.gov.co/Normatividad_Nuevo/Resoluci%C3%B3n%20No.%201035%20de%202022.pdf

23. World Health Organization. Global Patient Safety Action Plan 2021-2030 [internet]. 2021 [cited Apr 2021 19]. Available at: https://www.who.int/teams/integrated-health-services/patient-safety/policy/global-patient-safety-action-plan

24. Hignett S, Tutton W, Tatlock K. Human Factors Integration (HFI) in UK Healthcare: A route map for 1 year, 5 years, 10 years and 20 years. In: Charles R, Wilkinson J, editors. Contemporary Ergonomics 2017; Proceedings of the Annual Conference of the Chartered Institute of Ergonomics & Human Factors. London: Taylor & Francis; 2017. pp. 1-8.

25. World Health Organization, WHO Patient Safety. Patient safety curriculum guide: Multi-professional edition. [Internet]. 2011 [cited Apr 2021 19]. Available at: https://apps.who.int/iris/handle/10665/44641