

Ergonomic Risk Evaluation and Development of Musculoskeletal Disorders in Equatorial Health Workers

¹Dra. Stefany Selene Ayala Pilco ²Dr. Julio Alberto Pambabay Santacruz ³PhD., Juan Carlos Flores Diaz

1. estefanyayala1988@yahoo.com Código orcid: 0009-0000-1395-854X Filial: Maestrante de la Universidad Técnica del Norte.

2 juliopambabay@yahoo.com Código Orcid: 000-0001-9304-3808 Filial: Universidad Técnica del Norte

3 juanflore19887688@yahoo.com Código Orcid: 0000-0002-5721-9404 Filial: Instituto Tecnológico Superior ORIENTE, Maestría Tecnológica en Herramientas de Seguridad Industrial y Salud Laboral.

Cite this paper as: Dra. Stefany Selene Ayala Pilco, Julio Alberto Pambabay Santacruz, Juan Carlos Flores Diaz (2024) Ergonomic Risk Evaluation and Development of Musculoskeletal Disorders in Equatorial Health Workers. *Frontiers in Health Informatics*, 13 (3), 564.-578

Abstract

Introduction: Ergonomic risks are associated with working conditions related to postures, movements, and the physical environment. To assess the level of ergonomic risks for health professionals in a type C dispensary in Latacunga, Ecuador.

Methods: Based on the analysis of 91 employees of the preferred health center, with observation and records of working conditions on existing ergonomic risks, using a standardized Nordic questionnaire of perception of skeletal muscle symptoms, the REBA method is used to assess the degree of exposure of the worker to the risk of adopting inappropriate postures.

Results: Skeletal muscle symptomatology was identified at the level of the neck, shoulders, lower back, and knees; such findings have a higher proportion and a higher level of risk in the areas of physiotherapy, dentistry, and admission.

Conclusion: Due to the nature of the specialties and the high level of ergonomic risk, it is concluded that the viable alternative solution consists of rest and active breaks in the activities carried out with the implementation of preventive measures. However, due to the nature of the unchecked role, rotation of tasks to reduce such risks cannot be carried out for the therapist, dentist, and administrative staff in charge of the admission service of the Latacunga-Ecuador C-type health center.

Keywords: Skeletal muscle disorders, Ergonomic Risks, Reba Method, Standardized Nordic Questionnaire, Health Center.

Introduction

Ergonomics is a scientific discipline associated with the study of the interactions between human beings, the elements of an environment, products, and the work environment in order to optimize human well-being in accordance with the capabilities and limitations of individuals [1]. The World Health Organization (WHO) has defined ergonomic risks as any characteristic of an individual that increases the probability of suffering a musculoskeletal injury or disease produced in the workplace [2]; therefore, the objective of ergonomics will be to improve the life of the worker through design proposals and developments implemented by this discipline. In any case, as established by [3], this objective basically focuses on reducing risks and increasing the well-being and comfort of workers.

In 2018, the author mentions, with respect to musculoskeletal conditions, the set of inflammatory or degenerative injuries, with emphasis on the musculoskeletal system, that is, muscles, bones, tendons, ligaments, and nerves, which cause discomfort and disabling injuries and are irreversible. Musculoskeletal disorders are

one of the most frequent causes of occupational medical consultation and cause a notable decrease in performance and productivity in the professional field; for this reason, they are considered a work problem [4].

According to [4], it establishes that all health professionals in both public and private health institutions work in conditions of high incidence of musculoskeletal disorders, and due to this, there is a high rate of absenteeism, economically harming both the organization and the country in its general context. These professionals tend to develop some damage to their health because they spend a lot of time on their feet, have very long commutes, handle heavy loads, and undergo great emotional stress.

The Kourinka Nordic Questionnaire is a standardized questionnaire for the detection and analysis of musculoskeletal symptoms. It consists of 11 questions that refer to the presence of pain, fatigue, or discomfort in different areas of the body, including the neck, shoulders, arms, back, waist, legs, and feet. Questions are answered using a 5-point Likert scale (0 to 4), where 0 indicates no symptoms and 4 indicates severe symptoms. This instrument is applicable in the context of ergonomic or occupational health studies in order to detect the preexistence of initial symptoms in stages that have not yet been constituted as an occupational disease or have not yet led to consulting a doctor.

This questionnaire represents a simple and effective tool that can be used by occupational health, ergonomics, or medical professionals. Its application is recommended in any company or organization where tasks that may cause musculoskeletal disorders are carried out, such as repetitive manual work, extreme or static postures, lifting heavy loads, or exposure to vibrations, among others.

Therefore, this instrument constitutes an appropriate tool; it should be more widely used and disseminated in the context of occupational health, especially to detect musculoskeletal conditions in advance, preventing the appearance of occupational diseases associated with musculoskeletal disorders (MSDs), given its eminently preventive nature [5].

For its part, the REBA (Rapid Entire Body Assessment) ergonomic evaluation is a tool that allows evaluating the risk of musculoskeletal disorders associated with the adoption of inappropriate postures at work. It is a quick and easy method to apply and can be used by occupational health, ergonomics, or health and safety technicians.

At this point, it states that the REBA method is an observation method and is especially sensitive to skeletal muscle conditions since it assesses and analyzes the effects that may occur on the postural load of load management carried out with hands or with other parts of the body [6]. Through observation, it will allow the assessment of muscular activity caused by static or dynamic postures or due to sudden or unexpected changes.

Depending on the results, the REBA method informs the evaluator of the urgency of modifying the workers' postures and guides them in the correction of ergonomic anomalies to achieve greater comfort in the performance of their work. A qualitative analysis with the Kuorinka Nordic Questionnaire of 52 agricultural workers in the oil palm lifting activity revealed that 14.4% of the fruit lifters showed musculoskeletal injuries in different parts of the body in the last year [7].

The Kuorinka Nordic Questionnaire was used to test the prevalence of musculoskeletal disorders in dental services. The results obtained indicated that 12 dentists exhibited at least one physical discomfort, among the most relevant being in the neck (83%), lower back (67%), and right hand and wrist (42%). When carrying out the assessment with the REBA methodology of forced postures in the workplace, it was evident that the three postures analyzed had a medium risk, which is why the level of action was necessary [8].

The joint application of both instruments was observed in the application of Kuorinka's Nordic Questionnaire at the University Clinical Hospital of Valladolid (HCUV) during the first half of 2016. This allowed us to identify the prevalence of TME in the neck at 94.1%, in the shoulders at 64.7%, in the dorsum-lumbar area at 88.2%, in the elbow or forearm at 18.8%, and in the wrist or hands at 18.8%, as well as the identification of the

risks that these ailments entail, given the inferential analysis based on age, occupational category, current position, and ergonomic variables. The REBA method estimates that 11.8% of female workers perform high-risk tasks and 88.2% perform medium-risk tasks [9].

Based on the aforementioned, it is expected to obtain information that will allow us to identify ergonomic risks, analyze the level of risk to which workers are exposed, and then carry out an analysis to identify the most common musculoskeletal conditions in health center workers. Latacunga, on which this research focuses, is dedicated to providing general medicine, family medicine, emergency care, childbirth, laboratory, clinical psychology, physiotherapy, early stimulation, dentistry, cleaning, and user service services. It is considered that these personnel are the most exposed to these ergonomic risks because their work activity requires a lot of precision, static, and postural effort for a long time without much option to alternate between postures, which is why the muscular system is affected skeletally.

Materials and Methods

For the present investigation, a field design will be used, with metrics collected from a standardized instrument (Kuorinka's Nordic Questionnaire) corresponding to non-experimental cross-sectional data¹⁰, aimed at evaluating the ergonomic conditions of health personnel belonging to the Type C Latacunga dispensary in Ecuador.

Non-experimental cross-sectional studies are characterized by not manipulating the independent variables and measuring them as they occur in nature¹⁰. In addition to not establishing causality between the variables and the data, they are collected at a single moment in time without collecting additional data in the future. These types of cross-sectional studies are suited to the objectives of the present research; in this sense, they are useful to describe the prevalence of a condition or phenomenon, identify associations between variables, and predict the risk of developing a condition or phenomenon [11].

In support of the above, this study has been channeled with the purpose of responding to the research hypothesis formulated in terms of reducing the prevalence of musculoskeletal injuries in health personnel at the Type C Latacunga-Ecuador dispensary through the implementation of preventive measures ergonomics in the conditions of the work environment.

To respond to the formulated hypothesis, a descriptive statistical analysis was carried out to summarize and describe using the outputs generated by the Statgraphics Centurión software version 18.1.01 to establish indicators (counts, means, and standard deviations) and proportions, which synthesize the data in a concise way. The above, in order to obtain an overview of the data and identify initial trends or patterns. Likewise, inferential analysis was used, a methodology based on data treatment through the application of correlation analysis and logistic regression techniques, to draw conclusions beyond the observed data [11].

Study Population

The population under analysis includes doctors, nurses, administrative staff of the social area, among others who are involved in the provision of health services at the C Latacunga-Ecuador dispensary.

Based on the characterization of the population, the study framework necessary to consolidate the inferences of population behavior is defined. This framework is made up of 92 workers who work in the different areas and health services of the aforementioned health center, type dispensary C Latacunga-Ecuador (Table 1).

Table 1. Staff of the Latacunga Type C Health Center

Services:	Number of professionals:
Family Doctors	7
General Physicians	14
Nursing staff	14
Nursing Assistant	2
Dentists	5

Obstetricians	6
Psychologists	5
Dental assistant	3
Laboratory Technologist	6
Laboratory assistant	1
Therapists - Rehabilitation	5
Pharmaceutical Biochemists	2
Admission and user service analysts	1
Statistical assistant	5
Pharmacy assistant	2
SIS ECU Drivers	4
Paramedics SIS ECU	4
Nutritionist	1
Social worker	1
TAPS	3
TOTAL	91

Note: The table above describes the number of health professionals belonging to the Health Center. Source: Latacunga Type C Health Center.

Sampling Type

The applied sampling is characterized as non-probabilistic or intentional in nature, in which the methodology for selecting the participants in the study is carried out by convenience using its own selection criteria due to the small nature of the sample under study. Also, this sampling is suited to focus on specific groups, such as people with a medical condition or who have experienced a certain event [12].

Results

The results were divided into two categories: the evaluation of musculoskeletal conditions in workers of a health center, type C. Latacunga, 2023, applying the Nordic Kourinka Questionnaire, and the evaluation of ergonomic risks using the REBA method. The results and their respective analyses are presented below:

Table 1 presents the results regarding musculoskeletal pain or discomfort in the neck that occurs in both males and females. Of the male gender, 4.8% mention that they do not have any type of neck discomfort, while 16.1% mention that they do have neck discomfort. Of the female gender, 37.1% mention that they do not have any type of neck discomfort, while 41.9% report that they do have neck discomfort. As a result, the most affected gender is female in terms of neck discomfort. **Table 1.** Cross relationship between gender and pain or discomfort caused in the neck with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Neck Discomfort		No	Yeah	Total
Gender	Male	Count	3	10
		% of the total	4.80%	16.10%
	Female	Count	23	26
		% of the total	37.10%	41.90%
Total	Count	26	36	
	% of the total	41.90%	58.10%	

Note, Cross table GENDER Male = 1, Female = 2, others = 3*Neck NO=1, YES=2Almogbil et al. [13] point out that risk factors for neck pain include being female, associated chronic diseases, working more than eight hours of work per day, and suffering from bilateral shoulder pain. In a study conducted in Riyadh (United Kingdom, 2001), the risk factors identified for neck pain were excessive bending and twisting during daily work

[14], while in a study conducted in the Jazan region, musculoskeletal pain was related to mental disorders such as depressive symptoms and psychosomatic symptoms, which have a high prevalence in medical and nursing personnel.

Table 2 presents the results regarding musculoskeletal pain or discomfort in the shoulders that occurs in both males and females. Of the male gender, 17.7% mention that they do not have any type of shoulder discomfort, while 3.2% mention that they do have shoulder discomfort. Of the female gender, 58.1% mention that they do not have any type of shoulder discomfort, while 20.1% report that they do have shoulder discomfort. The result is that the most affected gender is female in terms of shoulder discomfort. **Table 2.** Cross relationship between gender and pain or discomfort caused in shoulders with respect to the total number of workers at the type C health center. Latacunga-Ecuador.

Inconvenience			Shoulders		Total
			No	Yeah	
Gender	Male	Count	11	2	13
		% of the total	17.70%	3.20%	20.90%
	Female	Count	36	13	49
		% of the total	58.10%	20.10%	70.10%
Total		Count	47	fifteen	62
		% of the total	75.00%	24.10%	100.00%

Note, Cross table GENDER Male = 1, Female = 2, others = 3* SHOULDER NO=1, YES=2.

The reported shoulder pain identified was similar to that reported by Dong et al. [15], who found that the prevalence of shoulder pain is high among Chinese public hospital workers, especially among tertiary hospital workers and among doctors. A variety of factors, including workload such as prolonged standing and individual and computer-related ergonomic factors, particularly in administrative workers, were associated with chronic pain among workers in these public hospitals.

Table 3 represents the results regarding musculoskeletal pain or discomfort in the shoulders, depending on the side, that occurs in both males and females. Of the male gender, 3.2% mention that they have discomfort in their right shoulders, while none of them mention if they have discomfort in their left shoulder. Of the female gender, 16.2% mention that they have discomfort in the right shoulder, while 3.2% report that they do have discomfort in the left shoulder. As a result, the most affected side in both genders is the right shoulder. **Table 3.** Cross relationship between gender and the side on which discomfort or shoulder pain occurs with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience			Sides		Total
			Right	Left	
Gender	Male	Count	2	0	2
		% of the total	3.20%	0.00%	3.20%
	Female	Count	10	2	12
		% of the total	16.20%	3.20%	19.40%
Total		Count	12	2	14
		% of the total	19.40%	3.20%	22.60%

Note, Cross Table Gender Male = 1, Female = 2, Other = 3* Right Side =1, Left=2The results were similar to those reported by Onda, Onozato, and Kimura [16], who point out that in a Japanese hospital, possible risk

factors for shoulder pain were found in staff who were working on the computer long-term, with female staff being more prevalent and presenting results that were unsatisfactory.

Table 4 shows the results in relation to musculoskeletal pain or discomfort in the elbows that occurs in both males and females. Of the male gender, 3.2% mention that they do not have any type of elbow discomfort, while 16.1% mention that they do have elbow discomfort. Of the female gender, 31.8% mention that they do not have any type of elbow discomfort, while 11.8% report that they do have elbow discomfort. The result is that the most affected gender is male in terms of discomfort in the elbows. **Table 4.** Cross-gender relationship with pain or discomfort in the elbow with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience		Elbow		Total	
		No	Yeah		
Gender	Male	Count	2	eleven	13
		% of the total	3.20%	16.10%	21.00%
	Female	Count	44	5	49
		% of the total	31.80%	11.80%	79.00%
Total		Count	46	16	62
		% of the total	74.20%	25.8%	100.00%

Note, Cross table Gender Male = 1, Female = 2, others = 3*ELBOW NO=1, YES=2The results found are similar to those reported by Cabezas-García and Torres-Lacomba [17], who point out that this type of pain is common among dentists, surgeons, doctors, and physiotherapists, where a high prevalence of pain in the elbow may be associated with the type of actions they perform, such as constant repetitive movements. In this study, elbow pain was reported by 15% of doctors, 20% of surgeons, 31.4% of dentists, 13.5% of physiotherapists, 2.6% of nurses, and 10% of technologists.

While in Table 5, the results are presented, including the prevalence based on gender (male or female) and the sides on which musculoskeletal discomfort or elbow pain occurs; of the male gender, only 3.2% mention that they have discomfort in the right elbow, while none mention if they have discomfort in the left elbow. Of the female gender, 4.8% mention that they have discomfort in the right elbow, while 3.2% report that they do have discomfort in the left elbow. As a result, the most affected side in both genders is the right shoulder. **Table 5.** Cross-prevalence relationship based on gender and the sides on which musculoskeletal discomfort or elbow pain occurs, with respect to the total number of workers at the type C health center.

Inconvenience		Sides		Total	
		Right	Left		
Gender	Male	Count	2	0	2
		% of the total	3.20%	0.00%	3.20%
	Female	Count	3	2	5
		% of the total	4.80%	3.20%	8.00%
Total		Count	5	2	7
		% of the total	8.00%	3.20%	11.30%

Note, Cross Table Gender Male = 1, Female = 2, Others = 3 *Right Sides=1, Left Sides=2

According to ElSayed et al. [18], elbow symptoms in particular are influenced by the arm placed on the edges of angular objects, which reveals in the results obtained that the greatest number of workers use the right arm and that the risk factors also increase due to repetitive movements in the form of flexion and extension of the elbow that cause poor functioning of the joint and its lubrication system.

Table 6 reflects results about musculoskeletal pain or discomfort in the wrists that occur in both males and females. Of the male gender, 16.1% mention that they do not have any type of wrist discomfort, while 4.8% mention that they do have wrist discomfort. Of the female gender, 59.6% mention that they do not have any type of wrist discomfort, while 19.5% report that they do have wrist discomfort. As a result, the most affected gender is female in terms of wrist discomfort.

Table 6. Cross-relationship of the prevalence of wrist pain or discomfort based on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience			Doll No	Yeah	Total
Gender	Male	Count	10	3	13
		% of the total	16.10%%	4.80%	21.00%
	Female	Count	37	12	49
		% of the total	59.60%	19.50%	79.00%
Total		Count	47	fifteen	62
		% of the total	75.80%	24.20%%	100.00%

Note, Cross table Gender Male = 1, Female = 2, Others = 3*WRIST No=1, Yes=2When considering the contributions of Ferguson et al. [19], it is decisive to emphasize that existing evidence shows that wrist pain is very prevalent in groups that carry out physically demanding activities on a daily basis, such as manual workers and athletes, which also includes medical personnel, especially dentists. , surgeons, and even administrative workers who use computer equipment frequently, while it is less prevalent in the general population and in white-collar workers.

Table 7 shows the results of musculoskeletal pain or discomfort in the upper back that occurs in both males and females. Of the male gender, 14.5% mention that they do not have any type of upper back discomfort, while 6.5% mention that they do have upper back discomfort. Of the female gender, 56.5% mention that they do not have any type of upper back discomfort, while 22.5% report that they do have upper back discomfort. As a result, the most affected gender is male in terms of upper back discomfort.

Table 7. Cross relationship of the prevalence of pain or discomfort in the upper back depending on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience			Upper Back No	Yeah	Total
Gender	Male	Count	9	4	13
		% of the total	14.50%	6.50%	21.00%
	Female	Count	35	14	49
		% of the total	56.50%	22.50%	79.00%
Total		Count	44	18	62
		% of the total	70.90%	29.10%	100.00%

Note, Cross table Gender Male = 1, Female = 2, Others = 3*High Back No=1, Yes=2In short, Pinto et al. [20] contradict these results since it indicates that the back is the region where there is the highest prevalence of pain in healthcare personnel, with 73%, with the most common causes being body mechanics, with 44%, followed by respective movements with 40 overweight with 36%, and that the frequency of pain manifests itself more frequently in nurses, followed by doctors, bioanalysts, and finally dentists with prevalence percentages of 50, 25, 19, and 17 respectively.

Table 8 allows us to observe the results regarding musculoskeletal pain or discomfort in the lower back that occurs in both males and females. Of the male gender, 9.6% mention that they do not have any type of lower

back discomfort, while 11.3% mention that they do have lower back discomfort. Of the female gender, 32.3% mention that they do not have any type of lower back discomfort, while 46.7% report that they do have lower back discomfort. As a result, the most affected gender is female in terms of lower back discomfort.

Table 8. Cross relationship of the prevalence of pain or discomfort in the lower back depending on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

		Lower back		Total	
		No	Yeah		
Gender	Male	Count	6	7	13
		% of the total	9.60%	11.3%	21.00%
	Female	Count	twenty	29	49
		% of the total	32.30%	46.70%	79.00%
Total		Count	26	36	62
		% of the total	41.90%	58.10%	100.00%

Note, Cross table Gender Male = 1, Female = 2, Others = 3*Lower Back No=1, Yes=2

Alnaami et al. [21] have pointed out that the prevalence of low back pain is high in health personnel, particularly dentists, paramedics, and nurses, and is associated with a positive history of back trauma in the form of trauma due to overexertion, falls, or lifting heavy objects. Back trauma from overexertion is more common among healthcare workers with long work hours and patient transfers.

Table 9 shows the results regarding musculoskeletal pain or discomfort in the hip and legs that occurs in both males and females. Of the male gender, 16.1% mention that they do not have any type of discomfort in their hips and legs, while 4.9% mention that they do have discomfort in their hips and legs. Of the female gender, 61.3% mention that they do not have any type of discomfort in their hips and legs, while 17.7% report that they do have discomfort in their hips and legs. The result is that the most affected gender is female in terms of discomfort in the hips and legs. **Table 9.** Cross-relationship between the prevalence of pain or discomfort in the hips and legs based on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

		One or Both Hips/Legs		Total	
		No	Yeah		
Gender	Male	Count	10	3	13
		% of the total	16.10%	4.90%	21.00%
	Female	Count	38	eleven	49
		% of the total	61.30%	17.70%	79.00%
Total		Count	48	14	62
		% of the total	77.40%	22.60%	100.00%

Note, Cross Table Gender Male = 1, Female = 2, Others = 3*One or Both Hips/Legs NO=1, YES=2The prevalence of hip pain in the present study is similar to the prevalence reported by González and Yabor-Labrada [22], who found that, in females over males, 65%. The area of work with the highest percentage was the operational area with 100%, and with an experience of 3 to 10 years of seniority in the institution, the affected area being the hip buttocks with 35%, the highest incidence in the female sex may be associated with age resulting from the appearance of osteoporosis, in addition to the factors already described above such as heavy loads and repetitive movements.

For its part, Table 10 reflects the findings in relation to musculoskeletal pain or discomfort in the knees that occurs in both males and females. Of the male gender, 35.3% mention that they do not have any type of knee discomfort, while 21.2% mention that they do have knee discomfort. Of the female gender, 27.1% mention that they do not have any type of knee discomfort, while 16.5% report that they do have knee discomfort. As a result,

the most affected gender is male in terms of knee discomfort.

Table 10. Cross-relationship of the prevalence of knee pain or discomfort based on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience			One or Both Knees		Total
			No	Yeah	
Gender	Male	Count	8	5	13
		% of the total	12.90%	8.10%	21.00%
	Female	Count	40	9	49
		% of the total	64.50%	14.50%	71.00%
Total		Count	48	14	62
		% of the total	77.40%	22.60%	100.00%

Note, Cross table GENDER Male = 1, Female = 2, others = 3*ONE OR BOTH KNEES NO=1, YES=2The results are similar to those reported by Osorio-Vasco & Rodríguez [23], who reported roller pain that ranged between 13 and 20%. Which, in the opinion of these authors, demonstrates how activities in the health sector carried out during prolonged periods of standing can cause skeletal muscle pain in workers in the lower extremities and lower back, as well as an increase in the volume of the legs.

Finally, Table 11 shows the results regarding musculoskeletal pain or discomfort in the ankles that occurs in both males and females. Of the male gender, 19.3% mention that they do not have any type of ankle discomfort, while 1.7% mention that they do have ankle discomfort. Of the female gender, 62.9% mention that they do not have any type of ankle discomfort, while 17.7% report that they do have ankle discomfort. As a result, the most affected gender is female in terms of ankle discomfort.

Table 11. Cross-relationship of the prevalence of pain or discomfort in the ankles based on gender, with respect to the total number of workers at the type C health center. Latacunga-Ecuador

Inconvenience			One or Both Ankles/Feet		Total
			No	Yeah	
Gender	Male	Count	12	1	13
		% of the total	19.30%	1.70%	21.00%
	Female	Count	39	10	49
		% of the total	62.90%	16.10%	79.00%
Total		Count	51	11	62
		% of the total	82.20%	17.70%	100.00%

Note, Cross table Gender Male = 1, Female = 2, others = 3*One or Both Ankles/Feet No=1, Yes=2Like the reports for the case of knees, Getie et al. [24] point out that in developing countries, nurses and health personnel in general are forced to work long hours and deal with a large number of patients. In addition to foot work, the use of inappropriate footwear means that the feet are exposed to low shock absorption, high friction force, and high impact force on the foot, causing strain, plantar fasciitis, and an abnormal arch, leading to ankle and foot pain.

Application of the REBA Method

The REBA method is an ergonomic assessment tool used to analyze and evaluate a person's working posture.

The above is achieved through the evaluation of the final score obtained by the aforementioned method, which is obtained by combining the scores of different elements, such as posture, repetitiveness, strength, and grip, among others.

Once the skeletal-muscular conditions were identified, the level of risks in forced postures present in the workers was evaluated using the REBA method based on the discriminated gender in the total staff of the type C health center Latacunga-Ecuador, described by the scale referenced in Table 12.

Table 12. Evaluation scale for estimating ergonomic risks applying the REBA method in workers at the type C health center. Latacunga

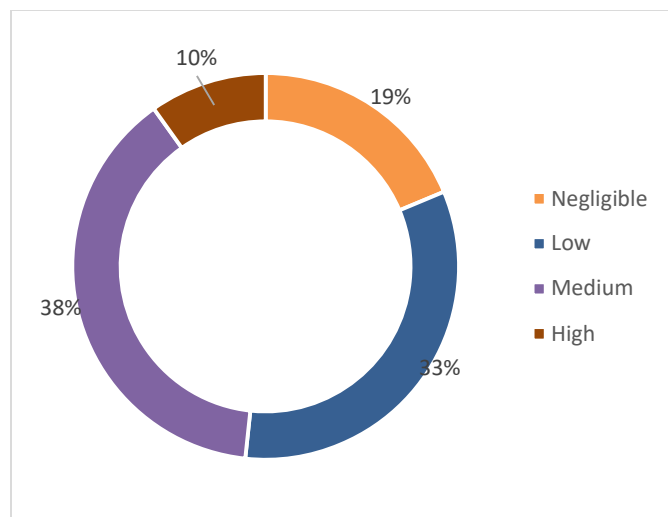
Punctuation	Level	Risk
1	0	Priceless
2-3	1	Low
4-7	2	Half
8-10	3	High
11-15	4	Very high

Note, Performance levels according to the final score obtained in the evaluation [25]

To obtain the performance table according to the final score obtained through the REBA method, the corresponding evaluation steps must be followed, taking into account the scores obtained in groups A (trunk, neck, and legs) and B (arm, forearm, and wrist), as well as the sum of strength and grip to obtain the table of C scores that tends to increase depending on the type of muscular activity developed in the task. Posture or repetitiveness scores can then be added as needed to obtain the final total score.

In terms of the previous theoretical support, the results of the evaluation are shown in Figure 1, where the ergonomic risks for the total number of workers (91) are summarized, highlighting that the majority of the proportion, equivalent to 35 workers in the health center, present a medium risk (38.46%), 30 a low risk (32.96%), 17 a negligible risk (18.68%), and 9 a high risk (9.8%). It should be noted that no worker presented ergonomic risks categorized as very high, which does not warrant immediate action in preventive or corrective measures.

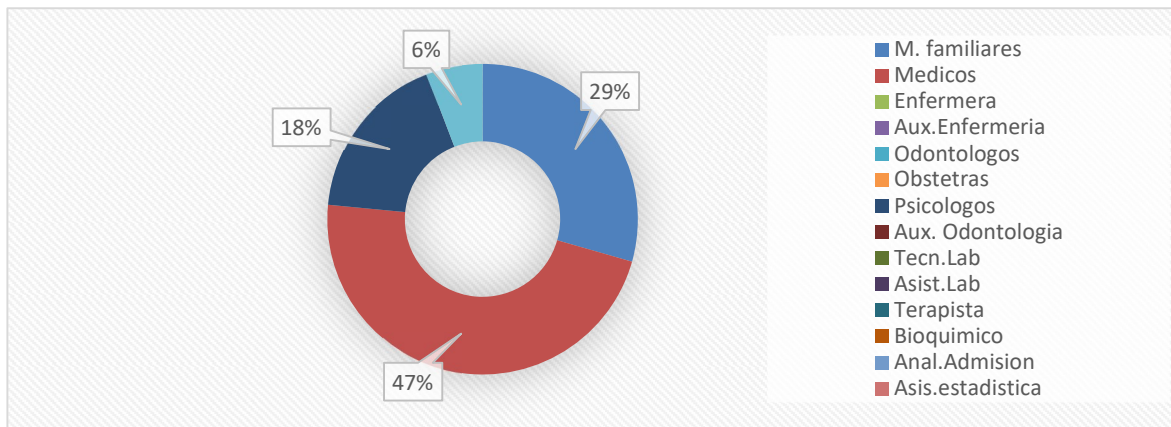
Fig.1. Percentage distribution of latent ergonomic risks in workers at the type C health center. Latacunga-Ecuador.



Note, Graphic representation generated by Statgraphics product of the results of the final punctures.

By evaluating how the latent ergonomic risks are distributed, it can be inferred that there is a high proportion of developing a medium and high risk in the personnel who work as psychologists, counted as 3, (3.29%), and paramedics as affected people. (1.09%). In contrast, there are personnel who are not required to implement any preventive measures to avoid any type of ergonomic risk. This situation is observed in eight general practitioners (8.79%) and five family doctors (5.55%), who mostly present a low risk (Figure 2)

Fig.2. Percentage distribution of latent ergonomic risks in the work areas of the type C health center. Latacunga-Ecuador

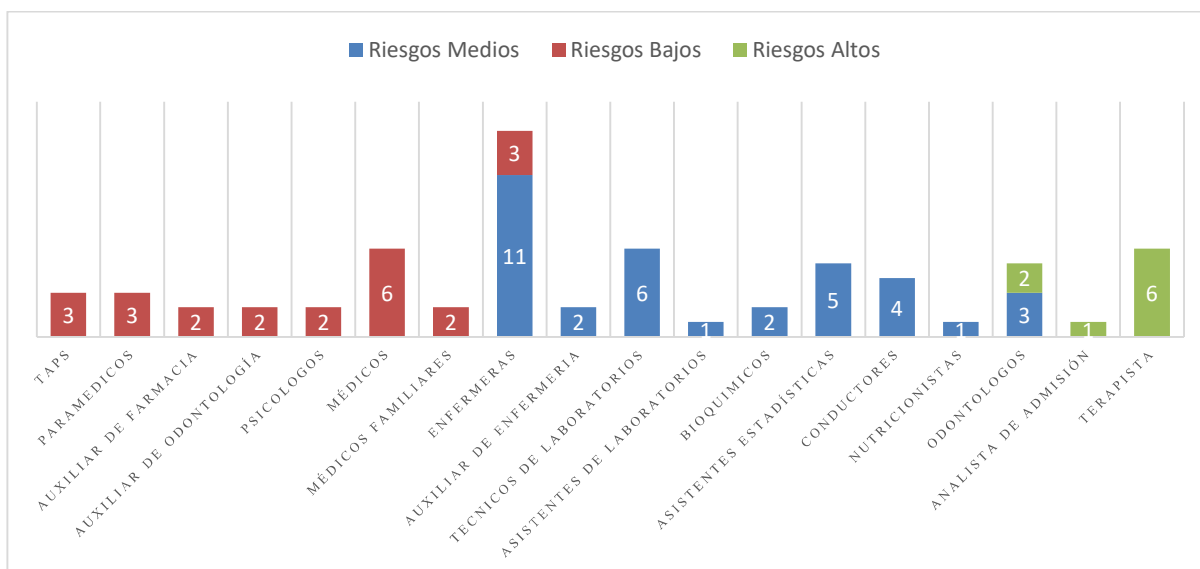


Note, Graphic representation generated by Statgraphics product of the results of the final punctures.

With respect to risks classified as low, that is, they sometimes require taking some preventive measure as a recommendation with a level of action on the evaluated posture to correct the certain level of risk.

In this situation, 6 doctors and obstetricians (6.59%) are observed, followed by paramedics and nurses, with 3 people characterized with this level of risk, representing 3.29%. In addition, the Taps staff, pharmacy assistants, dental assistants, and psychologists present only three people with low risks (2.20%), and only one social

Figure 3 Distribution of the ergonomic risk rating in the workers of the type C health center Latacunga-Ecuador



Note, Graphic representation generated by Statgraphics product of the results of the final punctures. In relation to risks classified as medium, it is determined that the nurses are characterized under this category with 11 employees (12.08%). That is, in this situation, preventive measures are required to avoid the risk with necessary action on the evaluated posture. They are followed by laboratory technicians and statistical assistants, with 6 and 5 people affected, representing 6.59 and 5.49%, respectively, while drivers and dentists have only 3 people with low risks (3.29%). Finally, the biochemists and nursing assistants presented by two workers with this average level of ergonomic risk are presented. In addition, a worker in the nutritionist area and a laboratory assistant fall under this characterization with 2.20% and 1.10%, respectively (see Figure 3).

Finally, in relation to the risks classified as high that require immediate action with preventive measures to prevent that level of risk from causing problems in the health of workers, according to such severity, it is seen in six of the therapists who present the highest prevalence. At this risk level (6.59%), followed by two dentists (2.20%), while an admission analyst presented these high risk levels (1.10%) within the Latacunga type C health center. Ecuador (See Figure 3).

The prevalence of a significant number of workers at medium and high risk levels after applying the REBA method coincides with what was indicated by Kumar et al. [26], who point out that the prevalence of musculoskeletal disorders is higher among health professionals even though they are knowledgeable about proper ergonomics in the workplace, with the lumbar area and the cervical region being the main areas that affect the majority of health professionals, especially among doctors, dentists, and nurses, as a consequence of poor posture, inadequate use of ergonomic environments, handling of patients with risky behaviors such as repetitive movements, and handling of heavy loads.

In accordance with Hita-Gutiérrez et al. [27], they tend to point out that one of the benefits of REBA is that it evaluates different parts of the body, such as the upper extremities (arm, forearm, and wrist), lower extremities, trunk, and neck, which makes it a useful method for identifying forced postures adopted by workers in order to develop improvement measures if necessary, such as active breaks, rest in the case of those who work standing, rotating shifts, and adaptation of furniture and equipment with ergonomic adaptations to reduce risks.

Conclusions

The REBA method is used to evaluate awkward postures at work and prevent health problems related to postural load. It allows you to analyze the positions of the upper limbs, trunk, neck, and legs. It is based on the RULA method and considers aspects such as the force used, the type of grip, and muscle activity. It is sensitive to tasks with unexpected postural changes and recommends corrective actions based on injury risk. The main objective of REBA is to evaluate the worker's exposure to risk due to inadequate posture.

When applying the standardized Nordic questionnaire for the identification of ergonomic risk factors in health workers at the Latacunga type C health center, the greatest musculoskeletal pain occurred in female workers, who reported the appearance of pain mainly in the lower back, upper back, shoulders, and neck, while only elbow pain was the one with the highest prevalence of pain in male workers.

Using the ergonomic evaluation of health workers at the Latacunga type C health center using the REBA method, it was found that the majority of health center workers had a greater tendency to develop medium and low risk levels than the occurrence of high risks. This ultimately translates into the adoption of preventive measures to mitigate medium risks and convert them into low risks for certain medical specialties and work areas. In addition, only certain urgent measures should be implemented in occasional cases to prevent the appearance of musculoskeletal pain in those workers with a high risk rating, given the severity of the affection and its possible consequences from a health and work point of view.

In essence, they should propose to managers the implementation of preventive measures focused on the establishment of appropriate work breaks according to the work day in which rest is the norm for the postures performed by workers, carrying out continuous evaluation of the activities and processes effectively compared with the training strategy, or constant training to address good ergonomic practices. Due to the nature of the

specialties and the high level of ergonomic risk, task rotation cannot be carried out to reduce such risks among therapy specialist workers, dentists, and administrative staff in charge of the admission service of the Latacunga type C health center, Ecuador.

Acknowledgement

None declared.

Conflict of interest: None declared.

Funding: None declared.

Ethical Considerations

Ethical considerations are based on the responsibilities of researchers towards their participants, their audience, their society and their academic communities.

Code of Ethics

None declared.

Authors' Contributions

The researchers contributed equally to the development of the research, wrote the manuscript and contributed to the collection of data. As well as the final review of the manuscript critically with approval of the final version.

References

1. Peñafiel. Factores de riesgo ergonómicos y la productividad laboral en el sector florícola. Trabajo de Titulación, previo a la obtención del Grado Académico de Magister en Administración de Empresas Mención en Sistemas Integrados de Gestión, Calidad, Seguridad y Ambiente. Ambato, Tungurahua, Ecuador: Universidad Técnica de Ambato; 2021. Available from: <https://repositorio.uta.edu.ec/bitstream/123456789/32898/1/027%20AE.pdf>
2. CETYS. CETYS Educación Continua. [Online]; 2021. Available from: <https://www.cetys.mx/educon/cuales-son-los-factores-de-riesgos-ergonomicos/>.
3. Tineo. Implementación de un programa de ergonomía para la disminución del riesgo postural en oficinistas de una empresa de seguridad patrimonial. Lima, Perú.: Universidad Nacional Mayor de San Marcos, Escuela Profesional de Ingeniería de Seguridad y Salud en el Trabajo; 2022. Available from: https://cybertesis.unmsm.edu.pe/bitstream/handle/20.500.12672/18807/Tineo_za.pdf?sequence=1.
4. Silva. Análisis comparativo de la carga física laboral y extralaboral, y trastornos músculos esqueléticos en los trabajadores de ambos sexos en el área de despresado de una empresa agroindustrial. 2018 Febrero 05: p. 1-114. Available from: <http://hdl.handle.net/123456789/4853>
5. Ibacache. Cuestionario Nórdico Estandarizado de Percepción de Síntomas Músculo Esqueléticos: Consideraciones acerca de la Utilización del Método en los Ambientes Laborales. ; 2019. Available from: <https://www.ispch.cl/sites/default/files/NTPercepcion Sintomas ME01-03062020A.pdf>.
6. Jumbo. Estimación de riesgos ergonómicos del personal de enfermería en unidad de cuidados intensivos del hospital Isidro Ayora, Loja abril 2022. Artículo Científico de Maestría en Enfermería con Mención en Enfermería de Cuidados Críticos. 2023; p. 1-24. Available from: <https://dspace.uniandes.edu.ec/bitstream/123456789/15995/1/UA-MEC-EAC-010-2023.pdf>.
7. Pincay et al. Posturas inadecuadas y su incidencia en trastornos. Rev Asociación Especialista Medicina del Trabajo. 2021 Junio; 30(2): p. 161-168. Available from: <https://scielo.isciii.es/pdf/medtra/v30n2/1132-6255-medtra-30-02-161.pdf>.

8. Álvarez. Relación de Trastornos Musculoesqueléticos en Odontólogos que adoptan Posturas Forzadas en un Hospital de la Ciudad de Quito. *Revista Tecnológica Ciencia Y Educación Edwards Deming*. 2020 Noviembre 24; 4(2). doi: <https://doi.org/10.37957/ed.v4i2.61>.
9. Paredes y Vásquez. Estudio descriptivo sobre las condiciones de trabajo y los trastornos musculoesqueléticos en el personal de enfermería (enfermeras y AAEE) de la Unidad de Cuidados Intensivos Pediátricos y Neonatales en el Hospital Clínico Universitario de Valladolid. *Medicina y Seguridad del Trabajo*. 2018 Junio; 64(251): p. 161-199. Available from: <http://hdl.handle.net/20.500.12105/12763>.
10. Hernández et al. *Metodología de la Investigación*. Cuarta ed. D.F.: McGraw-Hill; 2006.
11. Jiménez. *Metodología de la investigación*. 2018.
12. Garcés BEX. Proyecto de titulación en opción al grado de magister. Prevalencia de enfermedades musculoesqueléticas relacionadas a factor de riesgo ergonómico en la Constructora Alvarado proyecto Esmeraldas. Quito, Pichincha, Ecuador: Universidad Tecnológica de Israel.
13. Almogbil et al. Prevalence of Shoulder and Neck Pain Among Healthcare Workers in the Central Region of Saudi Arabia. *Cureus*. 2023 Julio 22; 15(7). doi:10.7759/cureus.42286
14. Lewis et al. Factores de Riesgo para el Dolor de Cuello: Estudio en la Población General. *Primary Care Sciences Research Centre, University of Keele, Staffordshire; ARC Epidemiology Research Unit, University of Manchester, Manchester*. 2001. doi: 10.1016/S0304-3959(01)00334-7.
15. Dong et al. Prevalence of neck/shoulder pain among public hospital workers in China and its associated factors: a cross-sectional study. *Scientific Reports*. 2020 Julio 23; 10(1).
16. Onda, Onozato & Kimura. Clinical features of neck and shoulder pain (Katakori) in Japanese hospital workers. *Fukushima Journal of Medical Science*. 2022 Junio 03; 68(2): p. 79-87. doi: <https://doi.org/10.1038/s41598-020-69382-4>.
17. Cabezas-García y Torres-Lacomba. Prevalencia de trastornos musculoesqueléticos relacionados con el trabajo en profesionales de los servicios de rehabilitación y unidades de fisioterapia. *Fisioterapia*. 2018 Marzo 07. Doi: <https://doi.org/10.1016/j.ft.2017.12.004>.
18. <https://doi.org/10.1016/j.ft.2017.12.004>.
19. ElSayed et al. Patterns of Work-related Musculoskeletal Disorders among Health Care Workers. *The Egyptian Journal of Hospital Medicine*. 2020 Octubre; 81(7): p. 2325-2334. doi:10.21608/EJHM.2020.131251
20. Ferguson et al. Wrist pain: a systematic review of prevalence and risk factors—what is the role of occupation and activity? *BMC musculoskeletal disorders*. 2019 Noviembre 14; 20(1): p. 1-13. doi: 10.1186/s12891-019-2902-8.
21. Pinto et al. Localización de lesiones osteomusculares por actividades relacionadas con el ejercicio profesional en el personal de salud: revisión de la literatura. *Cultura del Cuidado Enfermería*. 2019; 16(2): p. 78-87.
22. Alnaami et al. Prevalence and factors associated with low back pain among health care workers in southwestern Saudi Arabia. *BMC musculoskeletal disorders*. 2019 Febrero 08; 20(1): p. 1-7. doi:10.1186/s12891-019-2431-5
23. González y Yabor-Labrada. Musculoesqueléticas de los miembros inferiores en trabajadores de la salud de pie. *Revista Arbitrada Interdisciplinaria de Ciencias de la Salud, Salud y Vida*. 2022; 6(3): p. 432-

445. doi: <https://doi.org/10.35381/s.v.v6i3.2259>.
24. Osorio-Vasco & Rodríguez. Efectos del trabajo de pie en trabajadores del sector sanitario. *Revista Cuidarte*. 2021; 12(3). doi: <https://doi.org/10.15649/cuidarte.1790>.
25. Getie et al. Assessment of Knowledge and Attitude towards Palliative Care and Associated Factors among Nurses Working in North Wollo Hospitals. *Ethiop J Health Sci*. 2021 Marzo; 31(2): p. 393-400. doi:10.4314/ejhs.v31i2.22.
26. Diego-Mas. Ergonautas, Universidad Politécnica de Valencia. [Online].; 2015. Available from: <https://www.ergonautas.upv.es/metodos/reba/reba-ayuda.php>.
27. Kumar et al. A Review on Use of Rapid Entire Body Assessment (REBA) Tool to Evaluate Musculoskeletal Disorder Among Health Professionals. *World Wide Journal of Multidisciplinary Research and Development*. 2022 Agosto; 8(08): p. 1-8. Available from: https://wwjmr.com/upload/a-review-on-use-of-rapid-entire-body-assessment-reba-tool-to-evaluate-musculoskeletal-disorder-among-health-professionals_1660631437.pdf.
28. Hita-Gutiérrez et al. An overview of REBA method applications in the world. *International journal of environmental research and public health*. 2020; 17(8). doi: 10.3390/ijerph17082635.