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Articulo de revisión

Screening tools for work-related musculoskeletal symptoms among workers: A rapid review of the literature

Herramientas de tamizaje de síntomas musculoesqueléticos relacionados con el trabajo entre los trabajadores: una revisión rápida de la literatura

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Key contribution of the study

Objective	To evaluate the available screening tools for work-related musculoskeletal disorders in the working population
Study design	Literature review
Information sources	Google Scholar, PubMed, Embase, and Scopus
Population/sample	58 documents were included in the integrative review
Statistical analysis	N.A.
Main findings	Screening tools encompass aspects of work-related factors, psychosocial elements, and the working environment. Also, permits the prediction of work-related musculoskeletal disorders in specific musculoskeletal sites, facilitating the categorization of workers based on their risk of developing work-related musculoskeletal disorders and the necessity for medical consultation regarding their symptoms

Abstract

Background: Work-related musculoskeletal disorders (WRMD) is a public and occupational health problem as it increase costs, absenteeism, and productivity loss. Identifying work-related risk factors for the development of WRMD through screening tools is essential to determine and preventively treat patients.
Objective: To evaluate the available screening tools for WMSD in the working population.
Methods: A comprehensive rapid literature review was performed through a structured search. Inclusion criteria were: 1) screening tools for musculoskeletal disorders, 2) studies presenting analytical results such as proportion descriptions, sensitivity, specificity, positive predictive value, and negative predictive value, and 3) articles focusing on the working population.
Results: A total of 4,584 articles were identified, with a final count of 8 articles included in the review. Screening tools identified encompassed various aspects, including work-related factors, psychosocial elements, and the working environment. This inclusive approach enables the prediction of WRMD in specific musculoskeletal sites, facilitating the categorization of workers based on their risk of developing WRMD and the necessity for medical consultation regarding their symptoms.
Conclusion: Recognizing the broader societal and industrial impact of WRMD enhances the importance of advancing screening methodologies to address this health problem.
Keywords: Screening, Survey, Worker, Musculoskeletal pain, Orthopedic disorder

Abstract

Antecedentes: Los trastornos musculoesqueléticos relacionados con el trabajo (TMERT) son un problema de salud pública y laboral, ya que aumentan los costos, el ausentismo y la pérdida de productividad. Identificar los factores de riesgo laborales para el desarrollo de TMERT a través de herramientas de detección es esencial para determinar y tratar preventivamente a

los pacientes. Objetivo: de este estudio es sintetizar y evaluar las herramientas de detección disponibles para los TMERT en la población trabajadora.
Métodos: Se realizó una revisión bibliográfica rápida y exhaustiva mediante una búsqueda estructurada. Los criterios de inclusión fueron: 1) herramientas de detección para trastornos musculoesqueléticos, 2) estudios que presentaran resultados analíticos como descripciones de proporciones, sensibilidad, especificidad, valor predictivo positivo y valor predictivo negativo, y 3) artículos centrados en la población trabajadora.
Resultados: Se identificaron un total de 4,584 artículos, con un recuento final de 8 artículos incluidos en la revisión. Las herramientas de detección identificadas abarcaron diversos aspectos, incluidos factores relacionados con el trabajo, elementos psicosociales y el entorno laboral. Este enfoque inclusivo permite predecir los TMERT en sitios musculoesqueléticos específicos, facilitando la categorización de los trabajadores según su riesgo de desarrollar TMERT y la necesidad de consulta médica respecto a sus síntomas.
Conclusión: El reconocimiento del impacto societal e industrial más amplio de los TMERT aumenta la importancia de avanzar en las metodologías de detección para abordar este problema de salud.
Palabras clave: Tamizaje, encuesta, trabajador, dolor musculoesquelético, desorden ortopédico

Introduction

It is well known that the workforce community is vulnerable to multifactorial threats of physical and mental health issues (1,2). Work-related musculoskeletal disorders (WRMD) include various musculoskeletal diseases and injuries attributed to the work environment and occupational activities, such as tendinitis, epicondylitis, and carpal tunnel syndrome, among others (3).

The prevalence of WMSDs varies between countries, with an increasing trend of higher prevalence in low-middle-income countries. In the United States (US), WRMD prevalence fluctuates from 35.1% to 47%. In contrast, WRMD prevalence in Africa spans from 44.1% to 94% (4), and in Colombia in 2005, it was estimated that it affected 23,477 cases at the rate of 11.6 cases per 10,000 workers (5). Usually affects work that involves lifting heavy objects, working with the neck on prolonged flexion, performing repetitive-forceful tasks, and exposure to constant vibration. Consequently, the prevalence of the ratio of symptoms is estimated to be 50% higher in males rather than females (6).

WRMD is a public and occupational health problem. According to the National Institute for Occupational Safety and Health, WRMDs are accounted for 8 days away from work and represent an estimated economic burden of about 50 billion dollars (about $150 per person in the US) annually (7).

Therefore, prevention strategies at the job sites are needed. These problems can harm the health and well-being of individual employees and increase costs, absenteeism, and productivity loss for employers. It can also affect work-related performance and daily living activities outside of work (7,8). The problems are evident, and awareness has increased, yet effective interventions are missing.

Identifying work-related risk factors for the development of WRMD is essential to determine and preventively treating patients. It is key to find and implement the proper tools to distinguish the presence of these disorders (9). The use of occupational medical evaluations consists of the medical act through which a worker is questioned and examined to monitor exposure to risk factors and determine the existence of consequences for the person due to said exposure. Which can be done through a complete medical examination, laboratory tests, and surveys or questionnaires (10).

The objective of this study is to synthesize and evaluate the available screening tools for WMSD in the working population, considering their efficiency in identifying these health alterations in physical health that can affect their job performance.

Materials and Methods

Search strategy

A comprehensive rapid literature review was performed in January 2024, guided by the Cochrane rapid review recommendation guidelines (11). Articles were sourced from grey literature (Google Scholar) and through a structured search in indexed databases such as PubMed, Embase, and Scopus. The search was performed using the following search strategy; ("Medical examination" OR "Medical exam*" OR "Screening*" OR "Mass Screening*" OR "Survey*" OR "Questionnaire*" OR "Diagnosis" OR "Diagnostic Imaging") AND ("Musculoskeletal Disease" OR "Orthopedic disorder*" OR "Orthopedic disease" OR "Musculoskeletal Pain" OR "Musculoskeletal disorder*") AND ("Worker*" OR "Occupational groups"). A study-type filter was deliberately excluded to ensure a comprehensive overview of the subject matter. All relevant articles written in either English or Spanish published in the past 30 years (1994-2024) were considered.

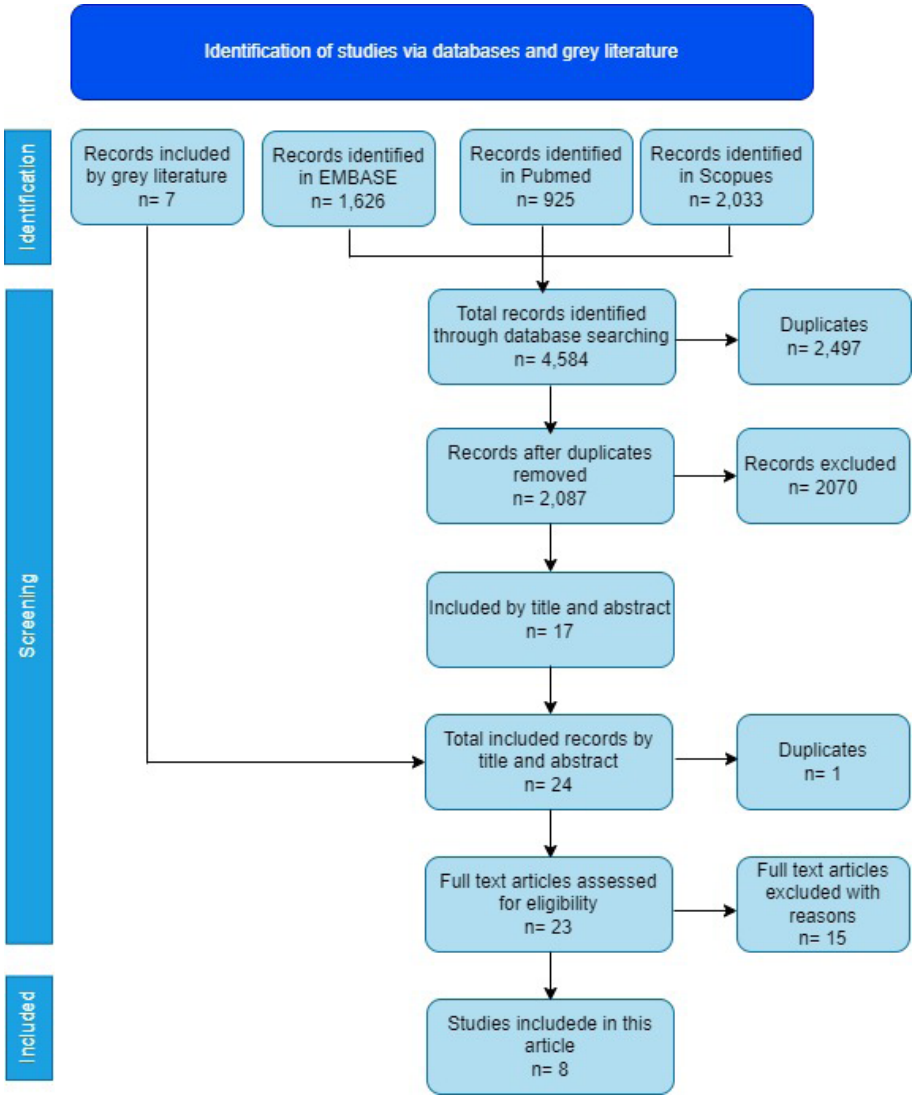

Figure 1. PRISMA flowchart diagram representing the employed literature search

Article selection

The initial screening was performed through Rayyan® (12), an AI-powered tool for systematic literature reviews, where articles were selected on the relevance of their titles and abstracts. Articles meeting this criterion were subjected to full-text analysis and included in the review only if they adhered to the following inclusion criteria: 1) the presence of screening tools for musculoskeletal disorders, 2) studies presenting analytical results such as proportion descriptions, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), and 3) articles focusing on the working population. Exclusion criteria comprised: 1) studies involving special populations such as pediatric, pregnant, and older age groups, and 2) screening tools with a focus divergent from work-related issues. Two reviewers performed article inclusion, and other two reviewers performed article exclusion; dual screening was established to prevent missing studies. The final compilation of information was organized to conform to the format requirements of a rapid literature review.

Results

In the search, a total of 4,584 articles were identified. Specifically, 1,626 results were retrieved from Embase, 925 from PubMed, and 2,033 from Scopus. Among these, 2,497 articles were eliminated due to duplication. Subsequently, the remaining 2,087 articles underwent a thorough review by the researchers, who assessed them based on title and abstract, resulting in the identification of 17 relevant articles. In addition to the database search, an exploration of grey literature yielded 6 more articles, bringing the final tally to 23 reports. The researchers meticulously reviewed these reports and applied inclusion and exclusion criteria, ultimately incorporating 8 articles into the comprehensive review. Figure 1 presents the PRISMA diagram depicting the selection process, adapted from Page et al (13).

We identified screening tools for WRMD that classified the risk region-specific work-related musculoskeletal disorders: A study assessed the predictive validity of the Neck pain-specific Health Behavior for Office Workers (NHBOW) and Neck Pain Risk score for Office Workers (NROW) in screening for neck pain among 342 office workers. The screening tool comprised 54 items distributed across six domains: psychological, decisional, social support, physical demands, job security, and workplace hazards. Notably, NHBOW exhibited superior performance in terms of sensitivity, specificity, positive predictive

value (PPV), and negative predictive value (NPV) compared to NROW, with values of 57.3%, 96.6%, 88.1%, and 83.6%, respectively, as opposed to 55.3%, 76.3%, 50.9%, and 79.4%, respectively (14). Likewise, Janwantanakul et al. (15), employed a screening tool to assess the risk of non-specific low back pain development in 615 office workers. The screening instrument incorporated individual factors, work-related physical factors, work environment considerations, and psychosocial aspects. The outcomes revealed a sensitivity of 65%, specificity of 68%, PPV of 16%, and NPV of 95%.

The Borg CR-10 scale, introduced in 1990, assessed perceived neck and lower back pain. Waongenngarm et al. (16), conducted a screening of 100 office workers over a 6-month follow-up period, with musculoskeletal pain assessed monthly using this scale, which gauges discomfort on a scale ranging from 0 to 10. Borg CR-10 scores equal to or greater than 3.5 predicted future neck pain occurrences with a sensitivity of 80% and specificity of 66%, and for predicting future low back pain with a sensitivity of 73% and specificity of 78%. Furthermore, perceived discomfort emerged as a statistically significant predictor of subsequent neck pain (OR: 10.33) and low back pain (OR: 11.81).

Baron et al. (17), assessed the reliability and validity of the Nordic Musculoskeletal Questionnaire (NMQ), a screening tool designed for WRMD. The NMQ incorporates information about demographics, work-related characteristics, and worker musculoskeletal discomfort and disability. To gauge the sensitivity and specificity of the NMQ across various musculoskeletal regions susceptible to WRMD (neck, shoulder, elbow, hand/wrist, and back), a cohort of 165 female workers representing diverse occupations was utilized. The findings revealed heightened sensitivity values for the detection of shoulder WRMD and increased specificity for the identification of elbow disorders. Similarly, Descatha et al. (18), conducted a study to assess the validity of two questionnaires in screening UEMSD. The Repetitive Task survey examined 1,757 participants, considering working conditions related to repetitive tasks such as assembling, packaging, and cashier duties. Three years post the baseline examination, 598 workers underwent re-evaluation. The diagnostic values for screening UEMSD in repetitive tasks were as follows: sensitivity 94.0%, specificity 81.4%, positive predictive value (PPV) 87.7%, and negative predictive value (NPV) 90.7%. Conversely, the Pays de la Loire survey assessed 2,685 workers in 2002-2003 for screening UEMSD, utilizing questions on work exposures and medical items. The resulting diagnostic values were sensitivity 100%, specificity 51.1%, PPV 100%, and NPV 23.2%.

In contrast, we also identified screening tools for WRMD that categorize patients with work-related musculoskeletal disorders into distinct risk groups. Following its development in 2021-2022 by Yazdanirad et al. (19), the CRAMUD tool was designed to evaluate the risk of musculoskeletal disorders. The screening tool was constructed using structural equation modeling and included 38 items distributed across three categories: physical, personal, and psychosocial factors. To assess reliability, a cohort of 300 male employees from a steel industry in Iran participated in the study. They were required to respond to the questionnaire regarding personal and psychosocial factors, while physical items were observed and documented by researchers through direct observation and participant interviews. A cutoff point exceeding 11.03 was identified to predict individuals with a high and very high risk of musculoskeletal disorders, demonstrating a sensitivity of 94.8% and specificity of 87%. The CRAMUD tool can be employed to accurately gauge the risk level of musculoskeletal symptoms across various occupations.

A scoring system aimed at quantifying the risk of clinically diagnosed upper-extremity musculoskeletal disorders (UEMSD) based on occupational factors was developed by Rapicault et al (20). This predictive score incorporated six physical exposure factors, three psychological work variables, and four work-related organizational factors. Subsequently, the diagnosis value of the screening tool was conducted in a validation sample comprising 1,051 workers. Results were categorized based on the score's threshold values. The results demonstrated an inverse correlation between the threshold values and sensitivity, ranging from 17% to 76%. On the other hand, specificity exhibited a positive relationship as the threshold values increased, ranging from 28% to 92%. The outcomes further revealed a range for positive predictive value (PPV) of 13% to 22% and for negative predictive value (NPV) of 89% to 90%.

Furthermore, Rujiret et al. (21), validated the Office-Check screening tool in 2023 among 223 office laborers to assess its efficacy in categorizing individuals as capable of self-management for specific symptoms or needing professional consultation for WRMD. The results demonstrated that the screening tool exhibited a sensitivity of 95.1%, specificity of 42.0%, PPV of 38.0%, and NPV of 95.8%.

Quantitative results concerning screening tools that classify the risk for region-specific WRMD are presented in Table 1. Likewise, Table 2 presents quantitative results for screening tools that categorize patients with WRMD into distinct risk groups.

Discussion

This rapid literature review aimed to synthesize and evaluate existing screening tools for WRMD, focusing on their effectiveness in identifying physical health alterations that may impact job performance. The review outlines the objectives of each screening tool, elucidates its methodological applications, and emphasizes results pertaining to the diagnostic value of the screening tool, including sensitivity, specificity, PPV, and NPV.

We identified valuable screening tools suitable for implementation in workplace settings, as they encompass various work-related aspects in an integrated form, offering benefits to workers. Certain screening tools assess distinct anatomical sites where WRMD may occur, such as neck pain (14,16,17), back pain (15,16), and pain in the shoulder, elbow, and hand (17) This is particularly crucial when a patient experiences pain at a specific site, facilitating a more targeted and effective approach to their condition.

Table 1. Quantitative results for screening tools that classify the risk for region-specific work-related musculoskeletal disorders

Author	Year	Tool Characteristics (Outcome)	Quantitative results			
			Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Areerak et al (14)	2018	Screening for neck pain				
		NHBOW	57.3	96.6	88.1	83.6
		NROW	55.3	76.3	50.9	79.4
Janwantanakul et al (15)	2015	Risk of developing non-specific low back pain	65	68	16	95
Waongenngarm et al (16)	2022	Screening for				
		Neck pain	80.0	66.0	65.0	80.0
		Low back pain	73.0	78.0	62.0	85.0
Baron et al. (17)	1996	Screening for musculoskeletal disorders:				
		Neck	66	84	-	-
		Shoulder	92	71	-	-
		Elbow	79	88	-	-
		Hand	67	76	-	-
Descatha et al (18)	2007	Evaluation of UEMSD through:				
		Repetitive task Survey	94.0	81.4	87.7	90.7
		Pays de la Loire Survey	100	51.1	100	23.2

NHBOW: Neck pain-specific Health Behavior for Office Workers. NROW: Neck Pain Risk score for Office Workers.

UEMSD: Upper-Extremity Musculoskeletal Disorders.

Similarly, screening tools also assess psychosocial aspects and the working environment (14,15,19,20). The study by Descatha et al. (18), evaluates repetitive tasks, such as assembling, packaging, and cashier duties. This is significant as it enables the assessment of WRMD based on the specific type of work performed. Workers engaged in repetitive tasks face an increased and apparent risk of WRMD.
The assessment of ergonomics in the workplace is a critical consideration, as activities involving a twisted or bent back, arms positioned above shoulder height, repetitive arm movements, and squatting have been associated with increased odds of developing WRMD (22). Additionally, the workstation design for a worker should include an appropriately adjusted chair height and armrest sections to mitigate the risk of WRMD (23). Prolonged sitting has also been linked to elevated odds of WRMD (OR: 2.00) (24).

While all screening tools exhibit varying performance regarding their sensitivity, specificity, NPV, and PPV, the primary goal of screening is to achieve high sensitivity. Among the tools that classify risk based on specific affected body regions, the Waongenngarm et al. (16), tool demonstrates superior performance for screening neck pain, achieving a sensitivity of 80%. This contrasts with other tools proposed by Areerak et al. (14), and Baron et al. (17), which reported sensitivities of 57.3% and 66%, respectively. For lower back pain, the performance is not as robust, with sensitivity ranging from 65% to 73% (15,16). In the case of UEMSD, the repetitive task survey analyzed by Descatha et al. (18), shows the highest sensitivity for detecting WRMD at this level, with a sensitivity of 94%. In comparison, Baron et al. tool reported sensitivities of 92%, 79%, and 67% for WRMDs in the shoulder, elbow, and hand, respectively (17).

Similarly, when comparing screening tools that categorize patients with WRMD into distinct risk groups, the tool developed by Yazdanirad et al. (19), demonstrates superior performance, with a sensitivity of 81.5% to 94.8% and a specificity of 79.7% to 93.5% for classifying patients into low-moderate, moderate-high, and high-very high-risk categories for developing WRMD. Therefore, it is recommended as a suitable screening tool for WRMD.
It is widely acknowledged that WRMD exerts effects beyond an individual's physical health. Various factors, including the severity of the condition, baseline health status, or age, can contribute to a substantial occupational impact. Previous surveys have highlighted a significant positive association between WRMD and indicators such as fatigue, stress, psychosocial distress, and sleep disruption (25), ultimately leading to a decline in the ability to function effectively at work. In many instances, this diminished productivity can manifest as presenteeism (attending work despite health problems) or absenteeism (being absent from work or taking sick leave due to health issues) (26).

Discussing the economic consequences of WMSDs is of utmost importance, encompassing implications not only for individuals but also for societies and industries at large. Waehrer et al. (27), have delineated a comprehensive framework comprising three categories for calculating the costs associated with WMSD.

Table 2. Quantitative results for screening tools that categorize patients with work-related musculoskeletal disorders into distinct risk groups

Author	Year	Tool Characteristics (Outcome)	Quantitative results			
			Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Yazdanirad et al (17)	2023	Risk of musculoskeletal disorders				
		Low and moderate risk	81.5	79.7	-	-
		Moderate and high risk	94.8	87.0	-	-
		High and very high risk	92.0	93.5	-	-
Rapicault et al (20)	2023	Risk for UEMSD by threshold values of score				
		≥5	76.3	28.4	13.0	90.0
		≥10	58.0	59.5	16.0	91.0
		≥15	36.9	79.0	19.2	90.0
		≥20	17.0	92.0	21.8	89.0
Rujiret et al (21)	2023	Screening for the need of medical consultation	95.1	42.0	38.0	95.8

UEMSD: Upper-Extremity Musculoskeletal Disorders

The first category, direct costs, encompasses medical expenses such as treatment, rehabilitation, medical equipment, and mental health interventions. The second category, indirect costs, calculated as lost wages, extends to employer productivity losses, covering expenses related to recruiting, training replacements, and administrative overheads, including worker's compensation programs. A study conducted by Haufler et al. revealed that between 2004 and 2006 in the European Union's population, the direct costs attributable to MSDs amounted to $576 billion euros (about $1,800 per person in the US), while the corresponding indirect costs reached $373 billion euros (about $1,100 per person in the US) during the same period (28). These findings underscore the substantial economic burden WMSD imposes, highlighting the imperative for further research and intervention strategies to mitigate these costs.

As previously mentioned, WRMD represents a considerable health concern for workers, with implications that extend beyond mere physical discomfort. Recent findings emphasize the impact of these disorders on mental health (29). Recognizing the interconnection between musculoskeletal and mental health is imperative for developing comprehensive and effective screening tools. Such tools should not only identify and prevent musculoskeletal disorders but also address associated mental health symptoms.

The correlation between persistent musculoskeletal pain and its psychological impact is well-established across various studies. Cesar et al. highlighted the association between WRMD and mental overload, contributing to mental disorders such as anxiety, depression, and sleep-wake cycle disorders (29). Additionally, Möckel et al. (30), study underscored a significant connection between chronic pain and elevated levels of depression, anxiety, and stress. Another study revealed a significant correlation between mental health problems and an increased likelihood of musculoskeletal pain among nurses in teaching hospitals (31). These findings underscore the importance of addressing both the physical and mental aspects when dealing with musculoskeletal pain.

In occupational health interventions, addressing both facets is crucial. Promoting awareness of mental health in relation to WRMD is pertinent, underscoring the necessity for integrated and comprehensive screening tools. These tools should capture the holistic dimensions of occupational well-being, facilitating the development of comprehensive workplace well-being programs that encompass both musculoskeletal and mental health.

Strengths and Limitations

This study exhibits strengths as literature was obtained through indexed databases and grey literature. The inclusion and exclusion criteria are clearly defined, contributing to the study's consistency and relevance. The rigorous screening process, facilitated by an AI-powered tool and dual screening by different reviewers, minimizes the risk of overlooking pertinent studies. Additionally, the use of a PRISMA diagram adds clarity to the selection process. Several types of screening tools were involved, allowing for a more complete evaluation of WRMD and providing a clear synthesis of the quantitative results of screening tools.

Despite its strengths, this study is not without limitations. There could be a potential language bias by excluding languages other than English or Spanish. Although several indexed databases were used, we

used MeSH and EMTREE terms to try to carry out a descriptive study, and this could limit the search and, therefore the available results, generating the involuntary exclusion of many studies. Moreover, there seems to be a limited availability of studies on the Latin-American population, which limits the generalizability of findings to other groups. However, this finding can be beneficial as it may promote investigation within this population and the creation of valid screening tools specific to these excluded inhabitants. These limitations should be considered when interpreting the study's findings.

Conclusions

The study adeptly synthesizes and evaluates diverse screening tools for WRMD, emphasizing their efficacy in identifying health alterations that influence physical well-being and job performance. These screening tools encompass various aspects, including work-related factors, psychosocial elements, and the working environment. This inclusive approach enables the prediction of WRMD in specific musculoskeletal sites, facilitating the categorization of workers based on their risk of developing WRMD and the necessity for medical consultation regarding their symptoms. It is crucial to underscore that WRMD incurs both direct costs (medical expenses) and indirect costs (lost wages, productivity losses) for individuals, employers, and society at large. The correlation between WRMD and the mental health of workers is noteworthy, contributing to elevated levels of depression, anxiety, and stress.

Furthermore, screening tools are typically implemented in specific populations, underscoring the need for additional research to develop tools applicable to diverse populations simultaneously. This recognition of the broader societal and industrial impact of WRMD enhances the importance of advancing screening methodologies to address this multifaceted health concern.

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