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Systematic Review Of Alternative Interventions For Construction Workers To Manage Work-Related Musculoskeletal Pain And Discomfort

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SYSTEMATIC REVIEW OF ALTERNATIVE INTERVENTIONS FOR CONSTRUCTION WORKERS TO MANAGE WORK-RELATED MUSCULOSKELETAL PAIN AND DISCOMFORT

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SYSTEMATIC REVIEW OF ALTERNATIVE INTERVENTIONS FOR CONSTRUCTION WORKERS TO MANAGE WORK-RELATED MUSCULOSKELETAL PAIN AND DISCOMFORT

by

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ABSTRACT

Background: The prevalence of Work-Related Musculoskeletal Pain and Discomfort (WRMSPD) among construction workers in 2017 was almost 20,000 injuries. Close to 60% were overexertion, others included lifting and lowering. The most common form of WRMSPD could originate from the upper back to lower back and neck pain. It was reported that the highest prevalence of WRMSPD were in the upper extremities (nearing 60%) because of the physically demanding factor of the job (heavy lifting and repetitive movement). Over 250,000 cases were reported to be WRMSPD in the private sector of the U.S. *Purpose:* The purpose of this systematic review was to investigate the effectiveness of alternative interventions for construction workers to rehabilitate pain and discomfort for WRMSPD. *Method:* A systematic search was conducted in databases including PubMed, Google Scholar, EBSCO/Medline/CINAHL/ PsycInfo, MEsH, Cochrane and Science Direct, CDC-NIOSH, BLS, and Science Direct for English articles published from 2016 to 2021. The PICO strategy guided the assessment of study relevance. In addition, randomized controlled trials (RTCs) and non-RTCs were accepted in the bibliographical search in which (1) subjects included adult construction workers that experienced or at risk of WMSPD, including specific and non-specific MSD and musculoskeletal pain, symptoms, and discomfort; (2) the intervention was initiated by the workplace, supported by the workplace and/or carried out at the workplace; (3) a comparison group was included, i.e. no treatment, treatment as usual, or another comparison treatment at the workplace; and (4) a measure of WMSPD, risk, or intervention impact, was reported towards the end of the study. The quality assessment and evidence synthesis were conducted using the tool for quantitative studies from the

Effective Public Health Practice Project (EPHPP). *Results:* From a total of 61 studies retrieved, articles 2 duplicates were removed leaving 59 articles. Additional records were identified from the CPWR. Following the inclusion criteria, 39 articles were read and analyzed to determine their eligibility. Five articles were selected that met all the criteria from a five-year gap of 2016-2021. From the quality appraisal, two studies were determined to have a high quality, one medium quality study, and one low quality study. The evidence synthesis consisted of 4 adequate studies that could be replicated as follows being ergonomics, participatory ergonomics, and health and safety exercises. *Conclusion:* The evidence synthesis indicated that the use of participatory ergonomics continues to be a common intervention for construction workers. Overall, there is very limited evidence from recent studies that supports the effectiveness of interventions. While there are some significant findings of a positive impact from intervention, including reduction of pain and injury events, there are few to no significant changes reported in most of the intervention studies.

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INTRODUCTION

Work-related musculoskeletal pain and discomfort (WRMSPD), also known as work-related musculoskeletal disorders (WMSD), is a condition that reduces the function and mobility across workers in the U.S. Construction workers account for the most significant mortality and fatality prevalence in the United States, with 21% described by the Occupational Safety and Health Administration (OSHA, 2018). WRMSPD impacts the U.S. economy by a total of 50 billion dollars per year, also requiring 70 million doctor visits per year (Wohlauer, 2021). With the constant stress due to the need to work, the construction worker will frequently risk themselves, thus creating a more significant gap of workers with low pain tolerance alongside chronic pain conditions. In the U.S. alone, there are approximately 11 million workers, to which construction is the largest sector. It is the highest of work-related injuries and chronic pain of musculoskeletal origin (Jacobsen, 2013). The conditions for WRMSPD are more prevalent when the work environment and performance of work contribute to the condition, and the condition is made worse, and the pain lasts longer due to work conditions (OSHA, 2021).

Previous studies dealing with construction workers and WRMSPD focused on understanding the prevalence among injuries reported and fatality rates in the different areas in the industry. Studies have shown that masonry workers, a branch from the construction trade, that apprentices suffer from WRMSPDs were highest in the upper back extremity at 58% (Anton, 2019). Construction workers are generally young in this industry. However, in 2017 the average after for the construction worker is 42.6 (Sokas, 2019). When the workers in construction get older and reach their 40's the prevalence

of MSD then increases by 25% (CDC, 2020). The pain from the construction workers can originate from the musculoskeletal origin, which is responsible for countless work-related injuries that lead to work-related pain (Woolf, 2012). Kachan et al. research has concluded that the construction industry has the highest prevalence of WRMSPDs, having a 1.83% also a 2.38; $p<0.0001$, concluding that the construction industry has the highest risk among all age groups injuries can take place (Kachan, 2011). In 2018, Manjourides conducted a simulated study using data from sparer et al, 2015, 2016 to measure both precision and relative bias on the amount of mobility observed by the construction industry. The goal of this literature was to estimate the effects at an organizational level of worker mobility and the impact on interventions by relying on surveys as a safety measure and not personally observing injuries (Manjourides, 2018).

Studies have concluded different purposes to modernize how wearables sensors can reduce work-related injuries that can translate to work-related MSDs. Zhao et al. observed through the study a consistently low rating for usefulness or preference for real-time injury risk warning, which created an effective wearable MSD prevention for the use for the construction industry (Zhao, 2021). Additionally, a similar study was also conducted with wearable sensors that measure roofers' physiological data to find a correlation between physical status and performance at the individual level. Lee et al. evaluated the individual's frequency of non-neutral ergonomic postures, and with the sensors, verified its feasibility in practice and informs the method of easier data acquisition (Lee, 2017). These studies are a more modernized approach in measuring WRMSPDs. However, the studies are too novel that replicated them would be challenging. Programs are crucial for assessing WRMSPD in the construction industry.

A program such as the Safety Voice for Ergonomics meets the requirements by conducting strategies that address ergonomic solutions, problem-solving, and speaking up to communicated solutions to reduce musculoskeletal injury risk (Kincl, 2016). In which the SAVE program was used to assess the prevalence of work-related musculoskeletal pain in masonry apprentices. Anton et al. Main objective for the study were to have the masonry apprentices participate and observed that the highest prevalence of MSD symptoms was lower back with 58% (Anton, 2019). These studies have mentioned the need to research this targeted demographic of construction workers due to the overwhelming evidence of WRMSPD in this industry.

Currently, there are few known published systematic reviews and about managing pain and discomfort with workplace interventions. There are even fewer that mention any focus among construction workers that have summarized the evidence conducted in published interventions. The need for a more updated systematic review is more evident currently because that are few mentions of literature that focus on construction workers that provided evidence that had alternative interventions. Brandt et al. mentioned the need for a systematic review of interventions focused on reducing work-related musculoskeletal disorders (WMSDs) in construction workers (Brandt, 2018). In addition, it is a challenge to illustrate a strategy that had the most favorable results were prevention and physical therapy for the reduction of upper extremity MSD among employers (Eerd,2016). A similar study was concluded for preventions and interventions and managing upper extremity MSD (UEMSD), which illustrated few studies that have a positive effect for UEMSD, but there is no "magic bullet" to reduce and alleviate UEMSDs. Erd et al. discussed a lack of guidance and literature to alleviate

symptoms of MDSs (Erd, 2016). Further illustrating, there is a need for a systematic review that illustrates different strategies with evidence-based approaches for rehabilitation and reduce discomfort in the construction sector.

This systematic review aims to identify and investigate the effectiveness of applied strategies among construction workers to rehabilitate pain and discomfort for WRMSPD. The WRMSPD interventions reviewed were either initiated by the workplace, supported by the workplace, or carried out at the workplace. The most recent interventions that engage construction workers in WRMSPD treatments and programs will be collected and synthesized. The evidence collected will be categorized into several intervention domains: physical exercise, ergonomics, participatory ergonomics, and simulated interventions. Further specific groups will divide the interventions into different categories.

METHODS

Study Design

The Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines were used to guide this systematic review. The search is a systematic process in conjunction with searching, extraction and combining evidence-based practices. No registration was done at this time.

Eligibility Criteria

Eligibility criteria can be seen in Table 1 illustrating the PICO employed for this systematic review. The PICO strategy guided the assessment of study relevance and the bibliography search for studies (1) Adult construction workers that have experienced or at risk of WMSPD (including specific and non-specific MSD and musculoskeletal pain, symptoms, and discomfort), (2) The intervention was initiated by the workplace, supported by the workplace and/or carried out at the workplace, (3) a comparison group was included (i.e. no treatment, treatment as usual, or another comparison treatment at the workplace), and (4) Measure of WMSPD, risk, or intervention impact was reported towards the end of the study (including musculoskeletal pain, symptoms, pain and discomfort Both RCTs and non-RCTs are eligible for inclusion in the review process. The review was limited to construction workers dealing with work-related injuries that can be translated to pain and discomfort. The status of pain was not a focus in this review, acute or chronic, as long as pain and discomfort were measured as MSD symptoms. Some of the injuries could be musculoskeletal based, and there needs to be alternative pain management strategies. Exclusion criteria for the paper were occupations not related to construction workers. Business or economic papers, if the

participations received an injury not from work. Alongside of lack of intervention practices, this also includes suggesting interventions instead of actual practices of interventions. Additionally, studies conducted outside the United States prior the year 2016 were also excluded. Finally, any papers that were dissertation and thesis for graduate work did not meet in the inclusion criteria.

Table 1. Illustration of the PICO used for the present review.

Population	P	Adult construction workers that have experienced or at risk of WMSPD (including specific and non-specific MSD and musculoskeletal pain, symptoms, and discomfort)
Intervention	I	The intervention was initiated by the workplace, supported by the workplace and/or carried out at the workplace (i.e. workplace-based)
Comparison	C	A comparison group was included (i.e. no treatment, treatment as usual, or another comparison treatment at the workplace)
Outcome	O	Measure of WMSPD, risk, or intervention impact was reported towards the end of the study (including musculoskeletal pain, symptoms, pain and discomfort)

SEARCH STRATEGY

This systematic literature review used the following scholarly databases: PubMed, Google Scholar, EBSCO/Medline/CINAHL/ PsycInfo, MEsH, Cochrane and Science Direct, CDC-NIOSH, BLS, and Science Direct. Additional organization databases were used for any additional studies which was the Center for Construction Research and Training (CPWR). These databases were chosen for their scientific articles and assisted in the search for relevant articles related to the objective (Table 2). The search consisted of the following key components: (1) Construction worker OR Construction sector OR Construction Industry OR Manual workers AND (2) Interventions OR Strategies OR Programs Or Treatment OR Therapy Or Management AND (3) Pain OR Discomfort OR Musculoskeletal disorders OR Musculoskeletal Injuries OR Work-Related Injuries AND (4) United States AND (5) 2016 to 2021. Manual

workers were included to broaden the search because some papers mentioned construction and manual workers in related fields. Additionally, a search through the citations from the studies originally collected were reviewed based on the key components: (1) Construction, (2) Musculoskeletal, (3) Intervention/Treatment, and (4) 2016, 2017, 2018, 2019, 2020, and 2021. This helped find any studies that did not come up in the initial pool of articles.

Studies that were not only in the English language were not part of pool of studies collected from the databases, but would have been part of the screening process for the inclusion and exclusion criteria. In additional, another component investigated was if there was any mention of Hispanic construction workers in the intervention studies. This component was searched but did not serve as a deciding factor in the inclusion criteria. It was an attempt to view any publications that have address this demographic among construction workers in the industry.

Assessment of Relevance and Inclusion

Inclusion for the paper mentioned to be concentrated in Construction workers / Construction sector or industry. The study must have been conducted in the United States from the years 2016 to 2021. This was to collect the most recent studies in regards to this topic and target population. The most recent systematic reviews in the past ten years have not focused on WRMSPD among construction workers in the United States. Intervention, programs or management strategies in relation with pain or discomfort needed to be implemented in the studies. Additional key words that were implemented for the search were with musculoskeletal disorders or musculoskeletal pain from a work-related injury or multiple injuries. The studies that were pooled from

the initial search, citation searches and CPWR were reviewed and assessed independently by first author (IR) and evaluated by senior author (Ibarra) and second senior author (Concha). Any disagreements were further discussed in separate meetings to avoid bias. A consensus was achieved after a final pool of studies was collected. First, titles and abstracts were screened and reviewed by a single reviewer (IR). Through the eligibility criteria, which is presented in the PICO table (Table 1), were included in the systematic review. The remaining full-text articles were further screened using the same eligibility criteria, with two reviewers (IR and Ibarra) independently reviewing and coming to consensus. A relevance criterion was revisited in each subsequent review step and articles were further excluded if the two reviewers were in consensus. The final pool of articles was then assessed for quality and evidence synthesis by first author (IR). After studies went through a quality assessment, studies rated strong and moderate quality were eligible for evidence synthesis. Studies that were considered weak did not move forward for data extraction, but a summary mentioned in the results.

Quality Appraisal

One reviewer (IR) independently evaluated the quality of each included study using the quality assessment tool for quantitative studies from the Effective Public Health Practice Project (EPHPP). Any misunderstanding or concern was discussed and further evaluated with the senior author (Ibarra) until a consensus was reached. The quality assessment tool has been used in many systematic reviews to evaluate the quality of the studies and reports that follow the inclusion criteria (Berghs, 2016). The tool consists of 8 components with the overall rating focusing on the first 6 components:

(A) Selection Bias, (B) Study Design, (C) Confounders, (D) Blinding, (E) Data Collection Method, and (F) Withdrawals and Dropouts. The last 2 components in the scaling tool are (G) Intervention Integrity and (H) Analyses. They do not affect the overall rating of high, moderate, or weak for the studies reviewed but important in ensuring the integrity of the study with an appropriate research question that is related to the topic of this review. After each component, a rating of the study was given strong, moderate or weak. The dictionary for the tool was used to help rate each study appropriately based on the responses to the questions for each component. Finally, the studies were divided into three main groups depending on their global rating: strong (no WEAK ratings), moderate (one WEAK rating), and weak (two or more WEAK ratings) (Berghs, 2016). Only high and moderate quality studies were eligible for further evidence synthesis. Studies that were rated weak would be summarized separately and not eligible for evidence synthesis because it would reduce the strength of this paper with a higher risk of bias from the reported results.

DATA EXTRACTION

Summary tables were created to sort studies included by intervention category and used for evidence synthesis. For each study, systematic data extraction was used for the following characteristics: 1) Author and year published, 2) Study Design, 3) Incentive, 4) Intervention Approach, 5) Level of Evidence, 6) Measured Variables, 7) Significant change, and 8) Significant Findings. The studies that showed to have potential relevance included several different outcome measures are related to WRMSD. To reduce bias, the tables were reviewed and consulted with the senior

author alongside the other coauthors. Any concerns involving study outcomes between reviewers were resolved by discussion until a consensus was achieved.

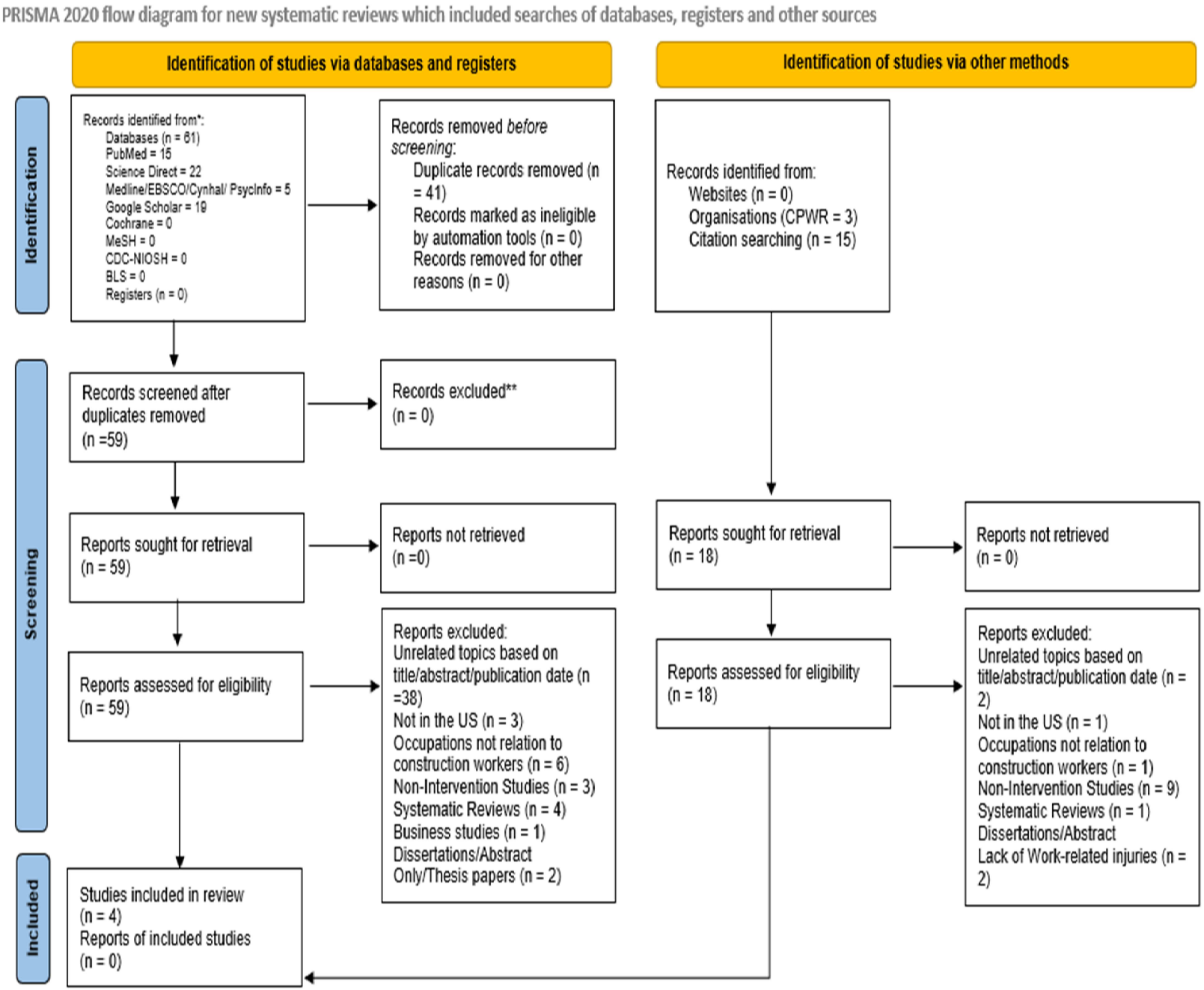
Evidence Synthesis

Using the EPHPP quality tool assisted in assessing the quality of the articles collected (Berghs, 2016). The synthesis focused on three levels of evidence, such as strong, moderate, and weak. The additional components in the EPHPP tool, (G) Intervention Integrity and (H) Analyses, helped further evaluate the intervention and finding consistency as part of the level of evidence. A systematic review was conducted based on the effect of the interventions towards the end of the study based on available quantitative results. Level of evidence was synthesized following strong and moderate quality studies from the intervention domains. Interventions that may not be effective towards the end or lack significant changes were summarized in Table 4.

RESULTS

Study Selection

The first search identified a total of 61 articles (Figure 1). After the removal of duplicates, a total of 59 articles remained for the abstract and title screening. All reports were available and retrieved to be reviewed using the inclusion and exclusion criteria. Of these, 38 articles were excluded based on title and abstract as they did not meet the inclusion criteria. A total of 39 full-text articles were read and reviewed to determine their eligibility. The number of reports excluded may be found in the PRSIMA 2020 flow diagram (Figure 1). Three additional records were identified from the Center for Construction Research and Training (CPWR) and 15 citation searches from the studies from the databases used were included in the screening process. Reports excluded from this second pool of studies may be found in Figure 1. Four remaining articles met the overall inclusion criteria. Table 2 summarized the characteristics of the included studies: (1) author and year, (2) purpose and aims, (3) study design, (4) location of study, (5) study population (n), (6) ethnicity and n (%), (7) quality appraisal (QA).



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Figure 1. PRISMA guideline tool for systematic reviews.

Table 2. Characteristic table for the studies included in this systematic review: (1) author and year, (2) purpose and aims, (3) study design, (4) location of study, (5) study population (n), (6) ethnicity and n (%), (7) quality appraisal (QA).

Author / Year	Purpose / Aims	Study Design	Location of Study	Study Population, n	Ethnicity, n (%)	QA
Hess, J. A. et. al. /2020	To evaluate the SAVE program, which is to provide detailed knowledge of ergonomic principles and solutions, plus problem sovling skills and strategies to speak up about hazards that may occur on the job.	RCT	12 training centers across the US (non-specified)	127 masonry apprentices	N/A	1
Schwatka, V. N et. al. /2019	A 2.5 hr Foundation for Safety Leadership (FSL) training program teaches construction supervisors the leadership skills they need to streagthen jobsite safey climate and reduce adverse safey-related outcomes towards their workers. The aims for the research were as follows: 1) if FSL-trained jobsite safey leaders would report imporved understanding and practice of the FSL leadership skills, safey and practices and crew reporting of safey related conditions, and 2) if their crew perceived a change in (a) theri supervisors' practices, (b) their own safety practices and reporting safety-related conditions and (c) overall jobsite safey climate.	QER	20 construction sub-contracting compatrins and randomly assigned to eith an early lagged-control traning goup Located in 3 geographic U.S. locations 14 in the West (Denver area) , 3 in the Midwest (Pittsburg, PA/Morgantown WV), and 3 in the East (Boston area).	Leaders (N=286) Workers (N=1173)	White: 110 (67%) Early - 79 (79%) Lagged Hispanic: 44 (27%) Early - 19 (19%) African American: 3 (2%) Early - 1 (1%) Native American: 2 (1%) Early - 0 Lagged Asian: 0 Mixed: 4 (2%) Early - 1 (1%) Lagged)	2
Peters, E. S et. al. / 2018	To examine the intervention-ARM, on commercial construction sites, using a mixed methods approach. The aims for this study were as follows: (1) a soft tissue injury prevention program on workers' perception of worksite ergonomic practices, new pain and injury incidences, and work limitations; and (2) a health promotion/health coaching (Health Week) program for diet leisure time physical activity, and reduced smoking behaviors.	C-RCT	10 commercial construction sites (5 intervention; 5 control) across the Boston metropolitan area, Massachusetts, US between 2014 and 2015	607 Total Construction Workers	White: 457 (77%) Black/AA: 57 (10%) Latino/Hispanic 35 (6%) Other 46 (8%)	1
Dale, A. M. et. al./2016	Using a logic model to evaluate a construction-based participatory ergonomic program (PE) to determine the extent to which the program was implemented as intended and determine the impact of a participatory ergonomics training intervention on construction worker learning, actions, health and injury risk	OLT	St. Louis, Missouri, US	86 construction workers from 7 small-sized constractors in 3 different construction trades	White: 85 (98.8%) NR: 1 (1.2%)	3

NR = Not Reported

SDA = Secondary Data Analysis

RCT = Randomized Control Trial

C-RCT = Cluster Radomized Control Trial

QER = Quasi-Experimental Retrsopective

OLT = Open-Label Trial

Note. 1 = Strong, 2 = Moderate, 3 = Weak

QUALITY APPRAISAL

This review was aimed to identify the effectiveness of interventions implemented towards constructions workers that may deal with or at risk of WRMSPD, we included articles describing this population and different key variables of WRMSPD. Two studies were classified as strong quality (no WEAK ratings), one study was moderate quality (one WEAK rating), and one study was low quality (two or more WEAK ratings). Three out of the four studies, as a result of only strong and moderate quality studies were eligible for evidence synthesis. A breakdown of how each paper was rated with the overall rating is seen in Table 3.

Table 3. Quality appraisal for literature in the paper.

Author / Year	Selection Bias	Study Design	Confounders	Blinding	Data Collection Method	Withdrawals and Dropouts	Global Rating
Hess et al./2020	1	1	1	1	1	NA	1
Sehwatcha et al./2019	2	3	2	1	1	NA	2
Peters et al./2018	1	1	2	1	1	1	1
Dale et al./ 2016	1	3	3	3	1	1	3
NA = Not Applicable							
Note. 1 = Strong, 2 = Moderate, 3 = Weak							

Data Extraction

One study was published in 2020, one study in 2019, and one in 2018. Three of the studies were RCTs, and one was a non-RCT. The study designs under “non-RCTs” included quasi-experimental retrospective study. The fourth study that was not eligible for evidence synthesis is an open-label trial which will be summarized and discussed separately. A summary of each study eligible for evidence synthesis was displayed with their outcome measures in Table 4 includes (1) author and year, (2) study design, (3) incentive, (4) intervention category and description (5) level of evidence, 6) Measured Variables, 7) Significant change, and 8) Significant Findings.

Categorization into Intervention Domains

The interventions across the four studies used for evidence synthesis were grouped into three intervention domains: health and safety exercise (n = 1), participatory ergonomics (n = 1), and ergonomics (n=1). One study did not match the main intervention domains and is therefore discussed separately. Two studies measured outcomes of musculoskeletal symptoms (Hess, 2020) and pain and injury incidences (Peters, 2018) in their respective intervention approach. One study focused on other WRMSD variables that construction workers at risk (Schwatka, 2019). Both positive and negative results were reported over the interventional effect from the included studies.

Evidence Synthesis

Level of evidence from the four studies eligible were synthesized based on three main intervention domains: Ergonomics, Participatory Ergonomics, and Health and Safety Practices. The level of evidence for each study can be seen in Table 4.

Ergonomics

Hess et al. blended learning principles that combined traditional face-to-face teaching methods taught by the IMI instructors (Hess, 2020). A secondary refresher was texted to every participant over several months to reinforce critical concepts taught in the units by using text messages.

Table 4. Evidence synthesis for literature in the paper.

Author / Year	Study Design	Incentive	Intervention Approach	Level of Evidence	Measured Variables	Significant Change	Significant Findings
Hess, J. A. et. al. /2020	RCT	NR	Ergonomics	1	1. MSD Symptoms 2. Ergonomic Practices	No significant changes among workers	All groups reported a high number of MSD symptoms, especially in the lower back and wrist/hand areas. survey questions from workers indicated that they were engaged in safety practice behond talking among themselves about safety hazards, which is a significant component of safety climate. Workers in the SAVE intervention group indicated they would recommend it to co-workers and found it useful to change their safety behavior.
Schwatka, V. N et. al. /2019	QER	$5 dollar incentive for each pre and post survey completed.	Health and Safety practices (non-specified ergonomic)	2	1. Leadership Skills 2. Safety Practices (Intervention Impact) 3. Safety Climate 4. Self-Reporting of safety-related conditions	1 & 2. Among Supervisors* No significant changes among workers	Only supervisors from the early group of the study reported a statistically significant improvement in the understanding and practice of leadership skills and safety practices.
Peters, E. S et. al. / 2018	C-RCT	A $5 gift card after completing the FUl surveys were given. A $20 for FU2 surveys and a $50 gift card was also provided from a sizeable hardware-chain store if the workers signed up for health coaching.	Participatory Ergonomics	1	1. Pain and Injury Incidences 2. Dietary Behaviors 3. Physical Activity Behaviors 4. Smoking 5. Ergonomic Practices 6. Physically Demanding Work 7. Work Limitations	1. p = 0.012* 2. p = 0.008* 3. p = 0.026* - 5. p = 0.002* 6. p = 0.008* 7. p = 0.432	Improvements were observed in physical activity, dietary behaviors, and ergonomic practices. Incidences of pain and injury reduced.

NR = Not Reported
RCT = Randomized Control
C-RCT = Cluster Radomized Control Trial
QER = Quasi-Experimental
Note. 1 = Strong, 2 = Moderate, 3 = Weak
*Note 2. * P ≤ 0.05 ** P ≤ 0.01 *** P ≤ 0.001*

Participatory Ergonomics

The ARM intervention was designed Peters study to integrated intervention components into the company's existing safety and health practices on the site (Peters, 2018). After the intervention activities, there was a significant improvement in the intervention compared to the control sites for ergonomic practices after adjusting for matched pairs, age, gender, race, job title, and trade.

In another study, each workgroup received training in ergonomics. During the training, each group was encouraged to identify high-risk work tasks and propose solutions using the available tools/equipment, knowledge, or experiences from co-workers, or previously proposed solutions provided by the researchers from past literature sources (Dale, 2016). A logic model provided in this study illustrated the progress of the health outcome. The PE program delivered to workgroups in three construction trades showed minimal short-term and intermediate impacts and no improvement in long-term health outcomes. With the process evaluation, the fidelity of the program was not achieved. While the summative showed that most workers reported an increase of knowledge and skill in ergonomic changes.

Health and Safety Exercises

Schwatka, V. N et al. Used an FSL intervention of a 2.5-hour training program designed to address the construction industry's need to improve foremen and frontline leaders' safety practices while strengthening the safety of the job climate and reducing the incidences of adverse health and safety outcomes (Schwatka, 2019)

DISCUSSION

ERGONOMICS

With the ergonomic intervention, the demographics from Hess et al. differed significantly with race/ethnicity, with the 30 OSHA training (Ps=.018, .001, and .003 respectively). Additionally, there were no significant MS symptoms among the groups in different number regions, P>0.180. With the test being 3 – 6 months, the SAVE program did not find any significant MS pain among the construction workers, which was a positive outcome from the author due to the goal of the SAVE program was to prevent cumulative trauma injuries, not treat them (Hess, 2020).

The main limitation of the Hess literature was having difficulties with following up with the participants, which threaten the validity of the study. The solution for the limitations was a robust follow-up that guaranteed the completion of the post questionnaire. Additionally, the participants were aware of the intervention, to which some participants took it as a competition, making a John Henry effect. Even though it was never confirmed that the John Henry effect had been at play, the author still emphasized the privacy of the study between the control group and non-control group to ensure validity for the following study (Hess, 2020).

The main objective was accomplished for this study by promoting the safety of the apprentices by applying ergonomic solutions and transparent communication to other workers for hazards in their job site. Different instructors are currently teaching the SAVE program in the construction sector due to its positivity among the apprentices. It currently is represented by 60 apprenticeship training centers across the United States (Hess, 2020). The positive evidence from the program further proved that when the

safety voice is high in the job site does reduce work-related injuries, but only if the supervisors' adoption of the program is conducted.

PARTICIPATORY ERGONOMICS

Participatory ergonomics is a co-operation of management and the workers which can also improve the perceptions held by employees concerning their job and the job-climate can become more positive (Laitinen,1998). Participatory ergonomics is reported to have a range of benefits and a reduction in MS injury, which can improve the understanding of useful information, improvement in the meaningfulness of work, more rapid technological and organizational change, and enhanced performance (Haims and Carayon, 1998). By doing participatory ergonomics, the workers have a better sense of empowerment over their job. This creates better opportunities for input and acknowledgment of using most of the worker's skills and knowledge (Burgess-Limmerick, 2018).

Participation for the Peters et al. Was moderate to high for data analysis, which was encouraging since it was all new workers. The demographic characteristics were not statistically different, being $p>0.05$ except for physically demanding work being $p<0.001$. The study conducted the ARM intervention with consisted of 1) Soft Tissue Injury Prevention Program (StIPP), which focused on ergonomic practices at the site and worker to improve MS health; and 2) Health Week, which integrated key messages and provided health coaching opportunities for the workers to improve ergonomic practices and also health behaviors associated with cardiovascular health. Furthermore, after adjusting for covariates, it was evident there was a 42% reduction in risk of having new pain or injury compared to control sites ($p=0.0012$). Specifically, the StIPP made

some minor improvements in the intervention and saw a slight reduction in physical job demands (Peters, 2018).

The objective was met by the research and intervention of the paper. It evaluated the efficacy of a construction worksite-based integrated intervention targeted both the conditions of work and the workers' health. There were improvements in both ergonomic practices on incidences of pain and injury and injury prevention programs, and there was also an improvement in physical activity that created positive health outcomes in the workers. The setbacks from the study were described as not addressing system-level components; while ergonomic training and practices improved, there was no significant change in the physical demands on the workers. Another example was that the ARM program needed complete communication between management and worker relationship. Since the program was fast paced, there was little time for pre-planning and completing the safety check from management to worker. This was the most limiting factor for the study due to the dependability of management participation, which varied from each site (Peters, 2018).

The strength of the paper was the study design alongside the wide variety of the general contractors and sites that participated in the study. Once you understand the challenges, the success of the program will be more achievable and replicable. Participatory ergonomics is the most effective study that can eliminate and redesign to reduce occupational musculoskeletal disorders' incidence (Burgess-Limerick, 2018). Additionally, a successful implication for PE methods to succeed would be effective teamwork, and practical problem solving is highly required.

Similarly, Dale et al. evaluated PE methods among constructions worker to reduce WRMSPD and reduce work-related injuries. The study was evaluation research. The main objective was to measure the outcome of an intervention on protective equipment using PE methods. Like other studies involving PE methods, management involvement was not met because it does not fit within the company's management system. Also, following up with the construction workers was also a challenge that did not meet the study's objective. Hence, future studies using a study design group-only could not test factors outside the program (Dale, 2016). Furthermore, the research was not a blinded randomized controlled trial. Per the instrument EPHPP, the quality of the paper was classified as weak. This was also for the lack of cofounders mentioned and the authors and participants not being blinded to the study, risking the study for bias. However, this research could propose an intervention based on PE if the research knows the limitations and strengths that will follow the study.

Health and Safety Exercises

With the Foundations for Safety (FSL), a 2.5-h training program emphasized frontline leaders' safety to have a safer and stronger job site. Additionally, in the different geographic locations (Denver, Pittsburg, Morgantown, and Boston area), trainers were also compensated for preparing and delivering the training for the workers. Even though it was not stated in the literature, recruitment success happens due to the incentive given to the leaders, trainers, and workers. For each survey and follow-up survey completed, workers received up to 5 dollars per survey. The participants for the studies were determined to be 55% that specialized in high-risk trade as the BLS defined it. From the leadership skills after the training, there was a

significant improvement at $p<.01$, and there was also an increase of safety practices being at $p<.01$ immediately after two weeks of training. However, after the two weeks, the lagged group did not have any significant changes in comparison to the control group (Schwatka, 2019).

The study's objective was to assess the FSL that affected many construction leaders and work-reported outcomes. There was an improvement among the leaders in the two to four-week period. Even though the workers only had a two-week improvement and remain stagnant for the last two weeks. The main limitation that the researchers mentioned is that the timeframe was too short for any additional follow-up to fully incorporate and put into practice the skills that were learned and increase the communication between leader and worker relationship. Another limitation mentioned was the high number of missing workers who could have resigned or been laid off, which resulted in the inability to accurately assess the training changes. To which a solution was conducted for potential future studies to average the workers' responses (Schwatka, 2019).

Finally, Schwatka et al, 2019 study’s goal is to have OSHA incorporate this training into their 30-hour course as an elective. This proposition is currently in the developmental phase. However, OSHA would most likely not agree to add to their course due to the growth of the construction industry and companies not finding it feasible to add any additional hours. Hence, the training could be adequate for the leaders and workers and immediately apply the training concepts in their job site. The benefits from health safety training could prevent work-related injuries by guaranteeing public safety by simplifying the work challenge of the construction worker. Safety is the

keyword for this training which fills the need for the construction frontline supervisors, which already reached 60,000 leaders with the potential for additional growth (Schwatka, 2019).

Opioid Epidemic

The opioid epidemic has a stronghold in the construction sector, and it is tightening its grip, to which there must be a solution to narrow the gap to benefit the worker. There is a lack of epidemiological data on drug information and drug usage, which is disproportionate among Hispanic workers with a high number of work-related injuries. It determined that a work-related injury could happen at a 35% probability weekly. In construction work, there is a 17% chance that a work-related injury can be sustained within the day, and the risk is higher among Hispanic workers when in contrast to its white counterpart (Dong, 2010). Furthermore, physicians will increase the dose of the items used by not addressing the proper pain management for the construction workers, creating a larger grip of opioids in the construction industry (Franklin, 2012). Thus, with this systematic review, the most common recommendation mentioned could be an alternative to manage WRMSPDs.

Strengths

Including RCT studies among other non-RCT, is a strength of this paper. There was only one quasi-experimental study that could downgrade the validity and strength of the review. By conducting the quality test of the EPHPP, the instrument's validity ensured the literature met several standards of the methodology that is also linked to the manner of evaluation and readability. Additionally, the EPHPP instruments also

ensure the risk of bias is not done by the authors because it may have higher reliability scores to assess studies, and it is often more tangible (Armijo-Olivo, 2012).

A recent study conducted their intervention of PE to measure the physical workloads in the construction sector. This study was conducted due to the need for a systematic review assessing the urgent need for interventions to reduce WMSPD among constructions workers (Brandt, 2018). There has not been another systematic review that evaluates alternative interventions towards construction workers dealing with WRMSPD in the past ten years. This review is to help reduce the gap with the most recent studies that have focused on WRMSPD among construction workers and evaluate the present need for future studies.

To further minimize bias for this review, rigor was required when analyzing the potential literature for data synthesis. Per table 3 issued the quality assessment questions that relate the intervention with the significant findings and randomization process from the literature. This further illustrates that the inclusion and exclusion criteria focused on having evidence-based practices that had adequate positive effects for the construction workers.

Finally, the search process of the specific keywords supported the rigor of the search of this paper. A systematic review of this rigor is needed to close the wide gap of the neglected demographic of the construction worker. This is due to recent systematic reviews of less than five years that have concentrated on the prevalence of MSD pain among workers, and very few concentrated on construction workers as a targeted population. This review further emphasizes the need for additional research, especially with a Hispanic/Latinx community co-founder. While it is a limitation further discussed, it

is a strength of this paper as well. Thus, providing a starting point to emphasize the additional need further to conduct a study or research this problem in the U.S./Mexico border.

LIMITATIONS

Although some studies on pain management and construction workers have been done on a national level, a lack of research in the U.S. - Mexico border is scarce and needed to improve the construction worker's pain management sufficiently. While some studies in this systematic review did have some Hispanic/Latinx participants in their studies. It was not the main focus of their program or study. This is a field in which researchers must continue, especially since there is a need to close the gap among Hispanics in the construction industry and work-related injuries at a national level (Dong, 2010). The Bureau of Labor Statistics accounts for employed workers, and 16.1 % of the 146.3 million are Hispanic. In addition, 27.3% of the workers are Hispanic or Latino (USBLS, 2014). It is clinically essential to measure the pain the construction worker faces to have a proper diagnosis for better pain management. From knowing the many risks of pain of the construction, developing and framework for companies to follow could assist with the pain-management. The pain from the construction workers can originate from the musculoskeletal origin, which is responsible for countless work-related injuries that lead to work-related pain (Woolf, 2012). There needs to be transparency on more accessible access to this construction worker in the U.S.- Mexico border to create a safe work environment.

Over the last ten years, over 2 million construction workers were of Latino origin or foreign-born. Hispanics are underrepresented in some way when dealing with the

construction sector, and it is more prevalent among the U.S./Mexico border to the lack of research being done. To this day, communication strategy is still crucial for an effective safety work environment because most materials are not bilingual. Some studies have been mentioned by the CPWR that ranged from the Safety Liaison Project, Adoption of Fall Prevention Measures, and the Telenovela Project (CPWR, 2014). Studies have been done; however, most of these studies require additional funding to continue their strategies and intervention.

While the interventions were significant, most of the studies did not see any significant changes in their specific participants in the short term of the study. This could be due to the limited time, and additional time was needed to further dive down into the prevalence and create better management strategies for WRMSPD. However, studies for strategies for managing WRMSPD are scarce, primarily located in the United States for over the last five years or more. Additionally, due to the ongoing COVID-19 pandemic, restrictions are still set in place. Hence, obtaining primary data is difficult to achieve given the right conditions.

Furthermore, when searching in the databases with the keywords. International papers mainly in the Scandinavia Peninsula (Norway, Sweden, Finland) were incredibly prominent. However, once the keyword "United States" was added, the search went from triple digits to single. This further emphasizes the need for this systematic review to help close the gap of pain and pain management among construction workers.

Luckily, studies have been publishing the need for interventions that reduce work-related injuries over the last two years, creating better pain management among construction workers. With technological involvement, it can be easier to measure

WRMSPD in the construction field. Brandt et al. described a study of a cluster randomized controlled trial via participatory ergonomics to measure general fatigue among construction workers. The intervention of participatory ergonomics with the three workshops did not reduce the number of accidents. However, the intervention group did increase general awareness of their work (Brandt, 2018). Additionally, a meta-analysis review emphasized having evidence regarding the prevalence of musculoskeletal disorders among constructions workers due to the information can then assist in developing interventions that can help manage work-related injuries or WRMSPDs (Umer, 2017).

CONCLUSION

This systematic review demonstrated the need for research for additional interventions for managing work-related injuries that can translate to WRMSPDs. To further elaborate, this was a five-year gap study which with the keywords alongside Boolean connectors being "Construction OR Manual AND Interventions OR Strategies OR Programs AND Pain OR Discomfort OR Musculoskeletal disorders AND United States," which gave less than 100 results from all the databases totals. Researchers must concentrate on interventions that can assist construction workers.

From the evidence of the literature, the intervention that can better assist WRMSPDs is participatory ergonomics. This methodology can be achieved if you are well aware of the limitations that can be imposed and how to adapt to whichever study is being done. This is because harnessing the knowledge and work expertise from the workers who participate in PE will have the potential to ensure optimal solutions and create a safe work climate (Burgess-Limerick, 2017). Overall, the most substantial literature from this review was the papers from Peters et al. and Hess et al. from the quality instrument EPHPP scored a 1 (Strong) on the global rating. This is due to their study design, the samples being heterogeneous, and the lack of biases in the study, which further increased the paper's validity.

While there are some significant findings of a positive impact from intervention, including reducing pain and injury events, there are few to no significant changes reported in most intervention studies. This is because the Hispanic/Latinx population is still growing, especially in the borderland. Thus, future research and research studies should be more concentrated in the U.S./Mexico border, which the target population is

Hispanic or Latinx ethnicity. The study will further close the gap and assist construction workers to assist WRMSPDs better.

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CURRICULUM VITA

Isaac Rodriguez, the youngest of three sons was born in Saltillo, Mexico, but moved a lot due to his father's career as a chemical engineer. In 2010, he began his colligate career at the University of Texas – Pan American, which is now known as the University of Texas – Rio Grande Valley. While pursuing his B.S. in Chemistry, he presented his research in analytical chemistry with Dr. Jason Parsons and worked for the Howard Hughes Medical Institute (HHMI program). After graduating in 2015, he applied and got accepted into Master of Public Health program at the University of Texas at El Paso (UTEP) in 2016. He worked various jobs during his time as a graduate student. He worked as a graduate assistant for Dr. Mangadu in her program Hasta La Vista, a radiation specialist for the Department of Public Health under the supervision of Ms. Mora, and as a science teacher at Anthony High School. In 2019, he started working with Dr. Carolina Valencia, director for the Rehabilitation program, and assisted in understanding the different psychosocial factors between Hispanics and non-Hispanic Whites. A manuscript was later published in 2020. Due to sudden changes with the COVID-19 pandemic in 2020, he got hired to work for Interprofessional Community of Practice (IPE) at UTEP by Dr. Patricia Lara, Dr. Jacob Martinez and Dr. Margie Padilla. He worked through the limitations of working remotely and virtual learning. He was able to effectively coordinate a virtual IPE to which other schools such as Texas-Tech at Lubbock have replicated. He presented an abstract on the Del Sol Conference at UTEP, and currently is on the process to publish a manuscript with his IPE team. Finally, with this Systematic Review he will work to publish his paper with his mentors and thesis committee.