



Prevalence of Musculoskeletal Disorders and Their Risk Factors among Professional Gardeners

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Abstract

Background: Work-related musculoskeletal disorders (WMSDs) are a significant occupational health issue, particularly among professional gardeners due to the physically demanding nature of their tasks. Prolonged awkward postures, repetitive activities, and heavy manual labor contribute to the high prevalence of these disorders.

Objective: To systematically review the prevalence, associated risk factors, and preventive strategies for WMSDs among professional gardeners.

Methods: A systematic review was conducted in accordance with PRISMA guidelines. Searches were performed in Ovid MEDLINE, CINAHL, EMBASE, and the Cochrane Database of Systematic Reviews for studies published up to May 2022. Inclusion criteria were peer-reviewed studies focusing on professional gardeners and reporting prevalence or risk factors of WMSDs. Data extraction included study design, population characteristics, outcomes, and risk assessments. Quality appraisal was performed using the Newcastle-Ottawa Scale and JBI tools.

Results: Fifteen descriptive studies met the inclusion criteria. Across studies, the most affected body regions were the lower back, knees, shoulders, and neck. Common risk factors included repetitive bending and twisting, heavy lifting, prolonged kneeling, and use of non-ergonomic tools. Prevalence rates for WMSDs were consistently high, with lower back pain being the most common complaint. Ergonomic interventions, training programs, and improved tool design showed potential in reducing injury risk.

Conclusion: Professional gardeners face a high burden of WMSDs, primarily due to physically strenuous tasks and poor ergonomic practices. Targeted preventive measures, including ergonomic modifications, worker training, and health monitoring, are essential to reduce the incidence of these disorders.

Keywords: Musculoskeletal Disorders, Professional Gardeners, Ergonomic Risk Factors, Occupational Health, Work-Related Injuries



Introduction

Gardening is the activity of tending and cultivating a garden. In gardening, Horticulture is the art of cultivating plants in gardens to produce food and medicinal ingredients. Horticulture focuses on sustainability on a much larger scale than gardening does. Essentially, horticulturists are the producers and providers of plants, while gardeners are strictly the consumers. Amateur sports or activities are done by people as a hobby and not as a job. A professional gardener is a person who is paid to work in someone else's garden. Quality of Care provided more by professional gardener than amateur gardener. Another important distinction between amateur and professional landscape companies is their commitment to total project safety. Professional gardener adhere to federal safety guidelines to ensure worker safety, including the use of Personal Protective Equipment for employees to reduce onsite accidents and injuries. In addition, professional gardener comply with standards for care and safety to help reduce accidents or property damage. Professional gardener offer a more robust variety of services, including Diagnostic Services to identify and treat potential issues threatening property health. Whereas amateur gardener might simply cut grass, prune shrubs, and trim trees. Mostly gardener do not get any medical benefit or periodic health check-up facilities from the management and their low socio economic condition compels to remain in same profession. With advancing age risk of condition increased. So professional gardening gradually debilitating for one's health. Whereas amateur gardening is good for your health it does not need any type of commitment to work they can left work at any time. This fact is especially significant for the workers involved in gardening since they are required to suffer physical strain in an environment that is contaminated by pesticides, dust, harsh cold, and a variety of allergenic weeds that impact the health of gardeners (1). The demands placed on one's musculoskeletal system by gardening are significant. In addition to operating powered equipment such as lawn mowers, line trimmers, chain saws, edges, hedge trimmers, leaf blowers, and wood chippers, gardeners are needed to operate heavy manual instruments such as shovels and hoes. The labor might include working in limited areas, on surfaces that are sloped or unstable, and even requires climbing trees to reach branches (2). Mowers, line trimmers, and several other equipment are often moved about the work site by being pushed and carried. It is necessary to load and unload gardening tools and supplies, plants, and organic waste from a variety of trucks and trailers. When planting or digging holes, you may spend extended amounts of time kneeling or in other positions that are not ideal for your back. If it is difficult to get to a tree, chain and hand saws may be used at unusual heights and angles (3). When using powered gardening tools, the user may be subjected to noise and vibration; gasoline-powered tools, such as lawn mowers, may create significant amounts of both of these factors (4). Damage to the body is often cumulative, not instant. Furthermore, such daily demands can result in mental fatigue (particularly in the latter part of the day) resulting in an injury

Number of studies found that the postures of stooping, kneeling, crouching, and twisting were the most unpleasant and risky when it came to gardening (5). The act of spading exposes participants to these dangers on several fronts. An uncomfortable and stagnant posture has been identified as a risk factor for work-related difficulties. Musculoskeletal disorders are the major cause of occupational ill health. Knee problems are common, and it is known that kneeling labor contributes to knee pain because of the extreme degree of knee flexion and the external pressure that is placed on the knees (6). Squatting requires a significant amount of bending in the knee joints (Arthritis) as well as the hip joints. Older gardeners are more likely to suffer from exhaustion, injury, and physical discomfort because of their unpleasant gardening postures. In addition, it was discovered that digging with a traditional shovel puts one at risk for a lower back injury (7). Work that is performed outside often involves more exposure to extremes of both hot and cold weather. Although the physical activity required to do routine gardening activities helps to mitigate the dangers presented by the cold weather, when the temperature is high it may make the already elevated risks of dehydration and heat stroke much worse (8, 9). Unfortunately, injuries sustained by professional gardeners are rather common and often quite serious. Between the years 2003 and 2008, there were about 1500 fatal workplace accidents in the United States (10). This accounted for 3.4 percent of all fatal injuries sustained on the job during that period, and the rate of fatal injuries



sustained by gardeners was more than 3.3 times that of the whole workforce. The most significant contributors to this pronounced injury burden were transportation incidents (primarily on-road motor vehicle collisions), contact with falling objects (primarily trees and logs), and falls from a higher level to the ground. These three categories accounted for the majority of the injuries that were sustained (11).

Musculoskeletal disorders are described as sets of conditions that impact the musculoskeletal system, which includes the muscles, tendons, joints, bones, nerves and other systems that support the muscles. (12) Musculoskeletal disorders are becoming an increasingly widespread health issue among Gardner as a direct result of the demanding physical labor they do. Shoulder discomfort, tenosynovitis, carpal tunnel syndrome, and similar conditions are examples of musculoskeletal ailments. The majority of those who call in ill to their jobs report suffering from back discomfort (13). A musculoskeletal disorder may cause a variety of symptoms, including aching, tingling, and numbness in the affected area. Occupation that requires a maintained posture and repeated job duties might be a cause for neck and shoulder issues, while hard physical labor and driving a motor vehicle are prominent reasons for low back discomfort. (14) Work-related musculoskeletal disorders (also known as WMSDs) are now one of the most prevalent issues that ergonomics practitioners have encountered. (15, 16).

Review of literature

One employed to care for the gardens or grounds of a home, business concern, or other property a professional gardener (Edith Oliver). Horticulture is the art of cultivating plants in gardens to produce food and medicinal ingredients, or for comfort and ornamental purposes. You could even say that horticulture focuses on sustainability on a much larger scale than gardening does. Essentially, horticulturists are the producers and providers of plants, while gardeners are strictly the consumers. Amateur sports or activities are done by people as a hobby and not as a job. A professional gardener is a person who is paid to work in someone else's garden. A person's exposure to these conditions is linked to inappropriate work postures, lengthy periods of activity, and the incorrect usage ergonomic principles (17). Gardeners were studied by Naeini et al.2020. When it comes to musculoskeletal issues, 15 percent of gardeners and landscape workers suffer from injuries caused by using hand tools while gardening, while 62 percent of employees need substantial posture modifications (18). Low back pain (LBP) affects 51% of employees while neck WMSDs affect 35%, according to a research by Hildebrandt and colleagues (19). In another research, agricultural workers had 434 injuries, with the majority of those injuries resulting from the use of hand tools (20). According to a research by Houshyar et al., the most common types of injuries suffered by gardeners are those involving the lower back, knees, and shoulders (21). According to a research done by Nandy et al., on gardeners and landscape workers, the lower back region was the most common location for the development of musculoskeletal diseases (1). For gardeners and farmers, Momenia et al. found that the most common sites for WMSD symptoms were the lower back, knees, upper back, and hips. In several ways of measuring the risk of musculoskeletal illnesses, posture assessment is used as the starting point for examination and analysis (22). Repetitive motions, uncomfortable posture, and biomechanical dangers are all present in greenhouse job, according to Varmazyar & Choubdar (2018). Greenhouse workers' risk of upper-limb injuries and musculoskeletal disorders (MSDs) were the focus of this investigation.

There were 50 greenhouse workers that participated in this descriptive and analytic research that was a cross-sectional study. An interview and a body map were used to gather information on MSDs. Risk factors for upper limb diseases were assessed using the OCRA and ACGIH-HAL procedures in six repetitive activities. Univariate logistic regression was used to analyze the data. According to their findings Sixty-two percent of the employees experienced upper-limb MSDs in the previous year. HAL-TLV and OCRA index were the highest in the grafting job (8.3 and 0.59). The fingers were the most painful part of the body (75 percent). Wrist, palm, and finger OCRA indices showed a significant relationship in the univariate regression test (OR=0.30, 95 percent CI=0.15-0.61;



OR=0.26, 95 percent CI=0.11–0.59; OR=0.21, 95 percent CI=0.08–0.51; respectively): MSDs were prevalent in the wrist to the extent that one-third of all cases were in this area. Pruning, weeding, and transplanting had a low risk, but grafting was the riskiest. Use ergonomic tools for grafting, trimming, and harvesting if possible. Training, job rotation, and extending rest time may all help lower the risk of repetitive stress injuries while weeding (23).

Amateur sports or activities are done by people as a hobby and not as a job. A gardener is a person who is paid to work in someone else's garden. There may be some health advantages to gardening, but the hunched and crouching postures that come with it might be unpleasant for certain people. Researchers set out to determine the kind of gardening activities older individuals conduct and their body postures while doing so to develop gardening programs for the elderly that are both safe and successful. During this study they observe 14 elderly gardeners on two consecutive occasions and noted the sorts of gardening jobs and postures they used while working in the garden. Older gardeners reported experiencing physical discomfort because of their labors in the garden. They observe seventeen distinct types of gardening activities. Ninety percent of the individuals employed six different body postures while completing the tasks: grasping, bending, walking, lifting, stretching, and standing up while doing them. The most common problem was lower back pain, with ten distinct types of pain recorded. According to these findings, elderly gardeners choose body postures when working in the garden that have the potential to be beneficial or harmful to their health. Kinematic and kinetic biomechanical analysis of gardening is required (24).

According to Lim et al., 2021 Workers with WRMSDs are regarded one of the leading causes of disability worldwide, which has a substantial economic effect owing to reduced productivity. In the service sector, landscaping is considered a high-risk business. WRMSDs are a problem for landscape workers because they are subjected to high physical demands at work and expend substantial physical effort to execute daily repetitive activities throughout extended working hours. The study's goal was to find out how often WRMSDs are among university landscaping workers, as well as the variables that increase their chance of developing them due to poor ergonomics. An ergonomic risk assessment (ERA) was carried out utilizing REBA, a quick complete body evaluation. Only 55 out of 60 landscapers consented to take part in the survey. A total of 85.5 percent of landscaping workers reported having WRMSDs. Based on their self-reported symptoms of WRMSD during the previous year, 65.5 percent of participants reported problems in the shoulder area, followed by neck (23.6 percent), wrist/hand (23.6 percent), and lower back (20 percent). Ergonomic risk assessment (ERA) performed by ERA-trained professionals indicated awkward posture as a risk factor. During the evaluation, no one's working position was found to be adequate. There was no significant difference in self-reported WRMSDs between landscape workers (71%) and REBA (29%) classifications, while most landscape workers were categorized as medium ergonomic risk group. Improvement in awareness campaigns, modification of working tools, and enhanced administrative approaches are among the control and prevention measures recommended to delay or prevent the occurrence of WRMSDs (25). There is a considerable problem in the health care industry with work-related musculoskeletal injuries and diseases (WMSD). As a result of their work, Allied Health Professionals (AHP) in this field are at an elevated risk of acquiring a WMSD due to both physical and psychological stressors. For WMSD risk management to be more effective, it is essential that the relevant hazards and risks associated with AHP be made clearer. The prevalence and risk factors of WMSD in AHP were determined by a comprehensive review of the scientific literature. An examination was made of the databases Ovid MEDLINE, CINAHL (EBSCO), EMBASE, and the Cochrane Database of Systematic Reviews. Outcome measures ranged from 28 to 96 percent over the course of a year, with prevalence rates varying widely. The most severely affected body part was the lower back. Inexperience in the function and area of work were among the relevant elements linked with the development of WMSD. High-quality prospective studies are needed in order to better understand the causes of WMSD in AHPs (26).



One of the most prevalent causes of Work-related Musculoskeletal Disorders is occupational exposure to ergonomic risk factors. This research intends to determine the incidence of WMSDs among gardeners and landscaping employees because of the variety of jobs they undertake. Worker duties were originally assessed using Hierarchical Job Analysis (HTA) in this research. 100 Yazd provincial garden and landscaping employees were then tested using the Rapid Entire Body Assessment (REBA) technique to determine their work postures. In addition, the Nordic Questionnaire (NQ) was employed to determine the prevalence of WMSDs. The data was analyzed using SPSS version 22. Both mowing (worst posture) and leaf collecting (longer posture) received a REBA final score of 8 (high) and 4 (medium) respectively. WMSDs were more common in the lower back and knee regions. Age and the occurrence of WMSDs in the neck and wrist region were shown to have a strong correlation. WMSDs in the elbow region were also shown to be linked to the sort of employment they were involved in. Ergonomic concerns should be considered while examining and improving these employees' working environment. To lessen the risk of developing work-related musculoskeletal disorders (WMSDs), it is advised that workers be educated in the effective application of ergonomic principles (27).

The elbow is a typical site for work-related musculoskeletal diseases, which have a significant influence on employees' health and productivity. Additionally, there is a significant absence of quantitative knowledge about physical risk factors related with certain elbow disorder. In the years 2007 to 2017, Medline, EMBASE, and Cochrane Work were searched for relevant studies. As a result of the GRADE framework for grading evidence, the discovered risk variables were classified into main- and sub-categories of exposure. In 10/524 papers, a total of 133 distinct risk-factor specifications were found, and they were divided into five primary exposure categories and sixteen subcategories. There was a strong correlation between the risk variables and ulnar neuropathy, medial epicondylitis, and lateral epicondylitis. Wrist rotational velocity (5°/s) and forearm supination (45° and 5% of the time paired with vigorous lifting) were determined to be significant risk factors (28).

Musculoskeletal disorder is the leading cause of occupational ill health, an awkward and static posture has been recognized as a risk factor for work related problems. The high degree of flexion of the knees and the external pressure on the knees in kneeling work are known contributors to knee complaints. While squatting, a maximal bending knee joints and hip joints are required. These uncomfortable gardening postures can cause fatigue, physical pain and injuries to gardeners. Moreover, digging with a conventional spade was determined to lead to lower back injury. (1)

Hypothesis

We hypothesize that professional gardening has a strong association with work-related musculoskeletal injuries and disorders (WMSDs) it may be linked uncomfortable gardening posture during their work. The professional gardeners have a hectic physical work profile. They have to work till the afternoon of summer and early morning in winter. This fact is also important for the personnel engaged in gardening as they have to undergo physical strain in an environment polluted by pesticides, dust, severe cold and different allergic weeds affecting health of gardeners.

Aims and objectives

The aim of this thesis was to perform a systematic review examining musculoskeletal disorder in gardener. This achieved by meeting the following objectives.

- To determine the prevalence of Work-related musculoskeletal injuries and disorders (WMSDs)
- To identify the association gardening and musculoskeletal disorders.
- To determine the potential risks and threats that could contribute to the development of WMSDs.
- To characterize the conclusions of a comprehensive evaluation of research that investigate the Gardening techniques and tools to reduce musculoskeletal disorders.



Material and Methods

Study design

Systematic review

Search strategy

A search protocol will be developed accordance with PRISMA standards, defining analysis and inclusion/exclusion criteria. Ovid MEDLINE (1948–May 2022), CINAHL (EBSCO) (1937–May 2022), EMBASE (Ovid) (1947–May 2022), and the Cochrane Database of Systematic Reviews (1991–May 2022) will be used for a literature search in June 2022. A search of databases for English-language articles will begin at the beginning of the project and continue until May of 2022. In order to guarantee that all relevant publications are found, reference lists from identified papers will be hand-searched.

MeSH terms (exploded) and free-text words will be searched using suitable acronyms and synonyms; applicable truncations; and wildcard symbols to guarantee that all spellings and variants of root words are considered. Keywords included in the search are listed below.

“Gardner, Musculoskeletal disease, musculoskeletal disorder, musculoskeletal injury, physiotherapy, exercise therapy, risk assessment.”

Sr. No	Search Terms
1	Epidemiology "OR " Epidemiological trend "OR "prevalence"
2	musculoskeletal diseases" OR "musculoskeletal" AND "diseases "OR "musculoskeletal disorders "
3	#1 AND #2
4	risk factor " OR ("risk" AND "factors") OR "risk factors"
5	"professionalized" OR "professionalizing " OR "professionals"
6	#4 AND #5
7	#3 AND #6
8	Gardener" OR "Gardeners" OR "Gardening"
9	#7 AND #8

Quality assessment

For the systematic review, we will utilize the Preferred Reporting Items for Systematic Reviews and Meta analyses (PRISMA) checklist and flowchart (Fig. 1) to guarantee comprehensive, transparent, and fair reporting. Depending on the study's design, one of the following tools will be used to conduct quality assessments: Quantitative Studies Critical Evaluation Form (29), the Critical Review Form for Qualitative Studies (30) from McMaster University, and, for systematic reviews, the Critical Appraisal Skills Programme (31). These quality checklists will be used to evaluate the included studies' bias risk, study design, and rigor.

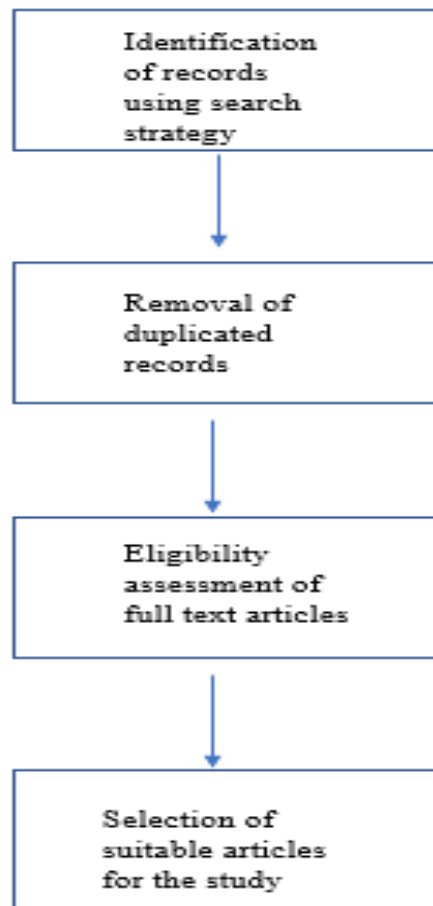


Figure 1: Flow chart of systematic review

Data extraction

The title and abstract of each research will be examined by the reviewer to see whether it is eligible for inclusion. There will be a re-evaluation of the abstracts that have been excluded to verify that no relevant papers have been omitted. To ensure that all articles meet the inclusion requirements, they will be examined again and if it does not meet the inclusion criteria it will be excluded. Study design, occupation, location, sample detail, outcome measure, prevalence measure and risk variables found are some of the features that will be retrieved and explained from the studies included.

Inclusion criteria

For inclusion in the current review, studies required a focus on professional gardener, to have reported WMSD prevalence rates or measured hazard and risk factors related to the development of WMSDs across all body sites. Inclusion will be limited to publications published in peer-reviewed journals. Experimental, observational, and qualitative investigations and systematic reviews included in the study designs. To gather new information, the researchers investigate the grey literature, they are used for reference and context in the intro & discussion.



Exclusion Criteria

This systematic review excluded editorials, letters to the editor, guidelines case reports.

Ethical Issues

The proposed method of investigation does not include any testing on either humans or animals. This endeavor does not include any ethical dilemmas or concerns in any way.

Time scale

A total of 12 months is required to complete this systematic review-based study.

Month 1-4: in months 1-4, data was collected for the study selected through.

Month 5-8: We searched the literature to find the association between gardening and musculoskeletal disorders.

Month 9-12: Based on all these systematic reviews about gardening and the MSDs, results was obtained.

Table 2: Calender

Activity	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Data Collection												
Assessment of eligible articles												
Result interpretation												

Results

Present throughout a person's working professional activity. These risk factors might include repeated activities, carrying large weights, incorrect postures, strenuous work activities, and so on. The upper limbs, neck, lower back, and lower limbs are the most important parts of the body that are affected by musculoskeletal disorders. The parts of the body that are affected by these disorders vary depending on the type of activity performed by the individual and exposure to the ergonomic risk factors (32). It is estimated that work-related illnesses of the musculoskeletal system are responsible for around forty percent of the total compensation paid by employers to employees across the globe (33). According to studies, WMSDs are the cause of more than half of all work absences that occur in the workplace (34). According to the International Labor Organization (ILO), one of the primary causes of the 160 million occupational disorders and 300 million occupational accidents that occur each year is work-related exposure to WMSDs (18). According to a survey published by the United States Bureau of Labor in 2014, WMSDs were the cause of 32 percent of non-fatal occupational illnesses and accidents, as well as 65 percent of occupational disorders in the United States. The prevalence of WMSDs in China is 86 percent on average over the course of one year, with the shoulder, neck, and lower back, respectively, being the organs



that are most often afflicted (35). It is estimated that in the United States, activities such as repetitive motion, abrupt motion, excessive force, and other similar activities account for more than 25 percent of the total compensation expenses given to employees. This amounts to more than 15.1 billion dollars in damages per year (36). It has been suggested that the term "work-related musculoskeletal disorders" should be used to refer to those conditions in which both the act of working and the working environment have a role in the incidence of musculoskeletal diseases (WMSDs). One of the primary factors that contribute to the development of WMSDs is prolonged bad posture (37). Other factors that might contribute to the development of these conditions include working in awkward postures, sitting or standing for extended periods of time during shifts, often and daily carrying and movement of heavy items and equipment, excessive force exertion, and so on (38). There are many people and employees all over the world who deal with all the risk factors listed above, both occupationally and non-occupationally, and inappropriate job postures, which significantly increase their risk of developing work-related musculoskeletal disorders (WMSDs). This puts them at a significantly higher risk of developing WMSDs (39).

Table 2: Reasons for exclusion of Studies

CATEGORY	DESCRIPTION
Wrong population	Subjects in the study had a condition that was not the condition being assessed in the current review i-e. professional gardener
Article not available	The author of the current review was not able to obtain the complete text of the articles.
Duplicate data/study	Data stated in the current review was reported already in some other studies.
Wrong language	The studies were published in languages other than English.
Wrong disorder	Subjects in the study had a condition (musculoskeletal problems) that was not due to gardening instead due to other agricultural activities.

Table 3: Excluded Studies

Sr. No	Excluded Studies	Reason of Exclusion
1.	Prevalence of Musculoskeletal Disorders in Gardeners(40)	Full article not available
2	Musculoskeletal disorders and correctional measures on fig gardeners in Estahban(41)	Musculoskeletal disorders was demonstrated with fig gardeners Only
3	Work-related Musculoskeletal Symptoms among Agricultural Workers(42)	study was demonstrated with all types of agricultural worker
4	Occupational exposure to airborne pollen and associated health risks among gardeners: a perception-based survey(43)	Study was demonstrated with non-musculoskeletal problems.
5	Prevalence of latent eosinophilia among occupational gardeners at Babcock University, Nigeria(44)	Study was demonstrated with non-musculoskeletal problems.

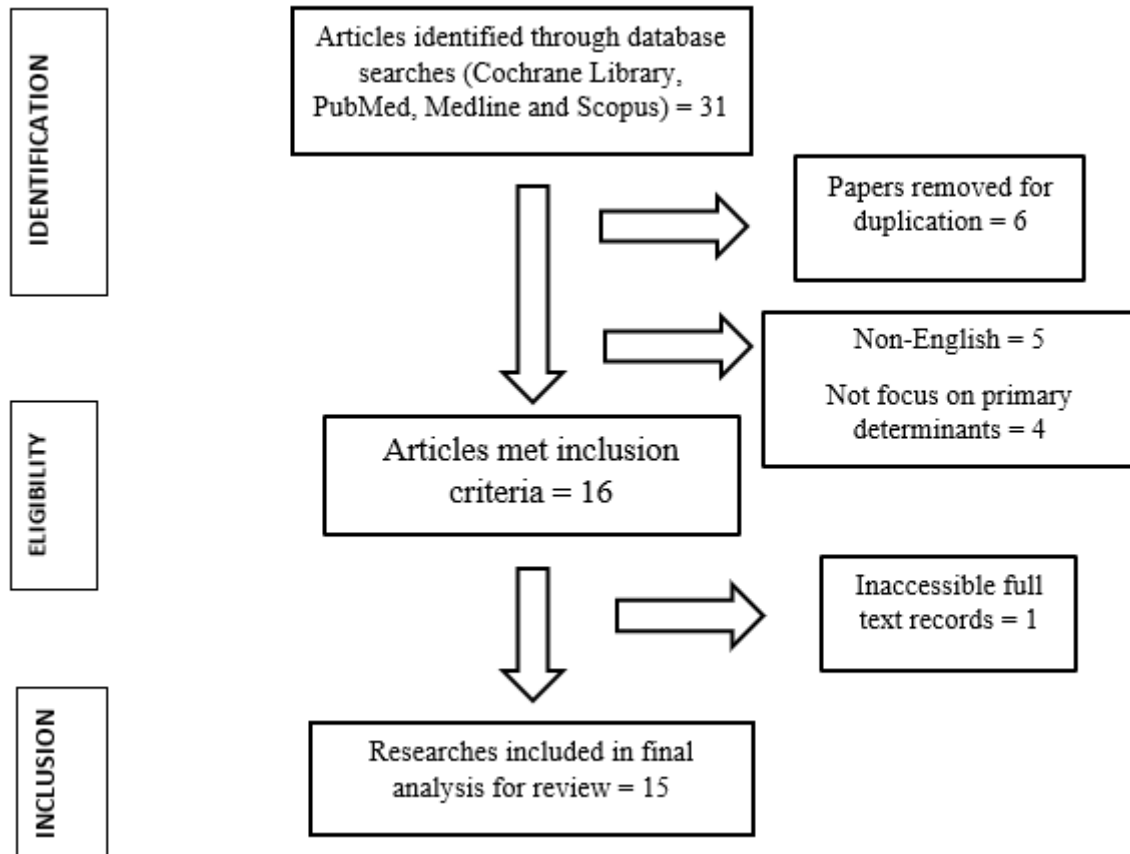


Figure 2: Prisma Flow Chart

Table 4: Summary of Article 1

Author year	Objective	Type of Study	Sample size/ Age years	Duration of Intervention	Outcome measures	Results
Robert Set al (45) 1998	Spade design, lumbar motions, risk of low-back injury and digging posture.	Experimental study	/mean= 27.6 year	5-dig trials	LMM(Lumbar Motion Monitor) LIDOKAS (2-dimensional video system)	Digging is a hazardous task when conventional spades are used , ergonomic redesign can reduce the risk of back injury



Table 5: Summary of Article 2

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Gangopadhyay et al.(46) 2006	The prevalence of musculoskeletal disorders among pre-adolescent agricultural workers of West Bengal, India : research article		00 9-12		modified Nordic questionnaire	It is evident from this study that these very young agricultural workers who are required to constantly bend and twists during work will experience transient fatigue, pain and eventually MSDs.

Table 6: Summary of Article 3

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Sin-Ae Park et al (24) 2009	Observing Body Position of Older Adults While Gardening for Health Benefits and Risks	Observational Study	14/ 63–86 year	2 month	Self – reported questionnaire	results show that Older gardeners use body positions during gardening that can provide both health benefits and risks. Biomechanical characterization of gardening through kinematics and kinetics is needed



Table 7: Summary of Article 4

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Gangopadhyay <i>et al.</i> (47) 2009	Ergonomics study on Musculoskeletal Disorders among female agricultural workers.	Observational study	50/ 17-20	5 year	modified Nordic questionnaire	It was observed that most of the subjects suffered discomfort, especially at the wrists, shoulders, hands, lower back and knees. Subjects suffered discomfort during work, after work and during sleep.

Table 8: Summary of Article 5

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Ev Innes <i>et al.</i> (48) 2009	Women's Health at Work Program: Musculoskeletal pain experienced by women of Chinese background working on market gardens in the Sydney Basin	descriptive study	07/ 21-60 years	four week period	Standardized Nordic Questionnaire CR-10 Pain Scale	The key issues identified as contributing factors to musculoskeletal pain and injuries were: (1) work practices (long Work hours, repetitive work); (2) biomechanical factors (repetitive and sustained work postures, poor manual handling practices) and limited training



Table 9: Summary of Article 6

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
<i>Papiya Bigoniy et al. (49) 2010</i>	A survey on the occupational health status of gardeners in Bhopal, India	survey	75/20-65			This survey reveals that 50% of gardeners are underweight, 31.99% with high normal to high blood pressure, and None with diabetes. The prevalence of vision disturbance (26.66%), eye inflammation (29.33%), stiff nose (21.33%), joint pain, swelling and muscle stiffness (29.33%), and accidental injury (28%) was significantly high among gardeners

Table 10: Summary of Article 7

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
<i>Alvarez et al (50) 2015</i>	Study of biomechanical overload in urban gardeners of Barcelona	Analytical study	29/20-55	12 month	video registration OCRA Checklist method	urban gardening tasks have a high level of requirements in The upper limbs. For this reason it is highly possible that a significant part of the working population will develop musculoskeletal disorders

Table 10: Summary of Article 8

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Hooshyar et al.(41) 2017	Musculoskeletal Disorders and Correctional Measures in the Gardeners	descriptive-analytic	170/Mean= 47.5 year	2 month	PATH QEC	Ergonomic interventions can be used as a corrective action and to reveal the problems and effects of musculoskeletal disorders in this group of farmers.

Table 12: Summary of Article 9

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Zahra et al (51) 2017	Work-related Musculoskeletal Symptoms among Agricultural Workers:	Cross-sectional Study	1501/ Mean= 41.39 year	12 month	Nordic Musculoskeletal Questionnaire (NMQ), Quick Exposure Check (QEC) technique, ergonomic working conditions checklist.	The results of NMQ showed the highest prevalence of MSD symptoms was related to lower back (59.3%), knees (36.9%), and upper back (36.6%). Indeed, the QEC score was high or very high (action levels 3 and 4) in 83.1% of the farmers. Moreover, the ergonomic working conditions checklist revealed that the participants' "working postures" index had the lowest mean.

Table 13: Summary of Article 10

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
<i>Subhadip Nandy et al. (1) 2017</i>	Musculoskeletal disorders among the gardeners: A cross sectional study	cross sectional study	60/ Mean =49.1	4 months	Modified Nordic questionnaire OWAS method.	Low back pain was the commonest musculoskeletal disorder in gardeners. It was followed Thigh, ankle and neck pain.

Table 14: Summary of Article 11

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
<i>Srivastava et al.(52) 2017</i>	Musculoskeletal Disorders of Gardening Labour Due To Hand Tools	cross sectional	120/ 20-50	10 month	Nordic Musculoskeletal Questionnaire	Majority of the gardeners (28.33%) feel ache, pain and discomfort once every day in area d of right hand. Majority of the gardeners (3.33%) feel very uncomfortable in area c and d of left hand when during work with hand tools. And majority of the gardeners (96.66%) feel experiences ache; pain and discomfort Slightly interfered in area d of left hand in their ability to work. I

Table 15: Summary of Article 12

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Hamid Reza et al.(27) 2021	Risk Assessment of Musculoskeletal Disorders among Gardening and Landscape Workers of Yazd Industrial Complex.	descriptive study	100/ 30-40	12 months	Nordic questionnaire REBA postural assessment method	The highest Prevalence of WMSDs was in the lower back and knee areas. A significant relationship was Found between aging and the prevalence of WMSDs in the neck and wrist area. Furthermore, a relationship was found between severity of WMSDs in the elbow area and the type of work activity

Table 16: Summary of Article 13

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Abid, A et al ⁽⁵³⁾ 2021	Frequency of Musculoskeletal Disorder of Upper Limb in Gardeners of Pakistan Horticulture Authority	observational study	185/ Mean=30.08 year	4 months	Quick Dash questionnaire VAS questionnaire	50(23.9%) reported with severe difficulty that was highest frequency reported for severe difficulty while doing garden work. Moderate difficulty reported with high frequency in gardeners while carrying heavy objects. Work activities reported like hammering with high frequency of inability to perform this activity due to disability.



Table 17: Summary of Article 14

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
Farideh Parak et al.(54) 2021	Analyzing Factors Affecting Reduction of Agricultural Occupational Injuries among Gardeners.	causal-correlational research	405/		researcher-made questionnaire	gardeners' participation in occupational safety and health training courses ($\beta = 0.80$) had the greatest impact on reducing agricultural occupational injuries among Gardeners. It should also be mentioned that variables horticultural education level ($\beta = 0.69$), horticultural income ($\beta = 0.68$), safety knowledge ($\beta = 0.67$), experience of horticultural activity ($\beta = 0.64$), Garden's size ($\beta = 0.60$), and gardener age ($\beta = 0.59$) were the next most powerful predictors of reducing Agricultural occupational injuries.



Table 18: Summary of Article 15

Author year	Objective	Type of Study	Sample size/ Age years	Duration of study	Outcome measures	Results
<i>Mei Ching et al</i> (55) 2021	Landscaping Work: Work-related Musculoskeletal Problems and Ergonomic Risk Factors	cross-sectional study	60/ Mean ≤ 44 years(83.9) Mean > 44 years(87.5)	12 month	NORDIC questionnaire REBA questionnaire	The highest prevalence involving the shoulder (65.5%), followed by neck (23.6%), wrist/hand (23.6%), and lower back (20.0%) regions based on their self-reported WRMSD symptoms over the past 12 months. Awkward posture was the risk factor identified. majority of the landscape workers (71%) were classified as medium ergonomic risk Group using REBA, with the remaining 29% considered to be high ergonomic risk group.



Figure 19: Quality assessment (Newcastle-Ottawa Scale)

Study				
	Selection	Comparability	Outcome;	Total score
Robert Set <i>et al.</i> (45)	4	0	3	7
Gangopadhyay <i>et al.</i> (46)	4	0	3	7
Sin-Ae Park <i>et al.</i> (24)	4	0	3	7
Gangopadhyay <i>et al.</i> (47)	4	0	3	7
Ev Innes <i>et al.</i> (48)	4	0	3	7
Papiya Bigoniy <i>et al.</i> (49)	4	0	3	7
Alvarez <i>et al.</i> (50)	4	0	3	7
Hooshyar <i>et al.</i> (41)	4	0	3	7
Zahra <i>et al.</i> (51)	4	0	3	7
Subhadip Nandy <i>et al.</i> (1)	4	0	3	7
Srivastava <i>et al.</i> (52)	4	0	3	7
Hamid Reza <i>et al.</i> (27)	4	0	3	7
Abid, A <i>et al.</i> (53)	4	0	3	7
Farideh Parak <i>et al.</i> (54)	4	0	3	7
Mei Ching <i>et al.</i> (55)	4	0	3	7

“Newcastle - Ottawa Quality Assessment Scale, physiotherapy evidence database; **1: Selection:** i) Representativeness of the sample: ii) Sample size iii) Non-respondents iv) Ascertainment of the exposure; **2: Comparability;** i) Assessment of the outcome: ii) Statistical test **3: Outcome;**

Table displays the individual scores on each article and the total scoring of the researches on the Newcastle - Ottawa scale; contains 8 items within 3 domain and the total maximum score is 9. A study with score from 7-9, has high quality, 4-6, high risk, and 0-3 very high risk of bias. (56)



Table 18: Risk of Bias Assessment Using the JBI tool

Study	Bias								Overall Bias
	Q-1	Q-2	Q-3	Q-4	Q-5	Q-6	Q-7	Q-8	
Robert Set <i>et al.</i> (45)	✓	✓	✓	✗	✓	✓	✗	✓	Low risk
Gangopadhyay <i>et al.</i> (46)	✓	✓	✗	✓	✓	✓	✗	✓	Low risk
Sin-Ae Park <i>et al.</i> (24)	✓	✓	?	✓	✓	?	?	✓	Low risk
Gangopadhyay <i>et al.</i> (47)	✓	✓	✗	✓	✓	✗	✓	✓	Low risk
Ev Innes <i>et al.</i> (48)	✓	✓	✓	✗	✓	✓	✓	✓	Low risk
Papiya Bigoniy <i>et al.</i> (49)	✓	✓	✓	✓	✓	✓	✗	✗	Low risk
Alvarez <i>et al.</i> (50)	?	✓	✓	✓	✗	?	✓	✗	Low risk
Hooshyar <i>et al.</i> (41)	✓	✓	✓	✗	✓	✓	✓	✗	Low risk
Zahra <i>et al.</i> (51)	✓	✗	✓	✗	✓	✓	✓	✓	Low risk
Subhadip Nandy <i>et al.</i> (1)	✓	✓	✗	✓	✓	✓	✗	✓	Low risk
Srivastava <i>et al.</i> (52)	✓	✓	?	✓	✓	?	?	✓	Low risk
Hamid Reza <i>et al.</i> (27)	✓	✓	✗	✓	✓	✓	✗	✓	Low risk
Abid, A <i>et al.</i> (53)	✓	✗	✓	✓	✓	✓	✓	✓	Low risk
Farideh Parak <i>et al.</i> (54)	✓	✗	✗	✓	✓	✗	✓	✓	Low risk
Mei Ching <i>et al.</i> (55)	✓	✓	✓	✓	✗	?	✓	✓	Low risk

There are four possible options ✓- Yes, ✗- No, ?- Unclear; Scores allotted: Y= 2, N= 0, UC=1.

1; Were the criteria for inclusion in the sample clearly defined.2; Were the study subjects and the setting described in detail.3; Was the exposure measured in a valid and reliable way.4; Were objective, standard criteria used for measurement of the condition.5; Were confounding factors identified?.6; were strategies to deal with confounding factors stated.7; were the outcomes measured in a valid and reliable way.8. Was appropriate statistical analysis used.(57)

Key: ✗ High Risk of Bias

✓ Low Risk of Bias

? Unclear Risk of Bias



Discussion

Agriculture is one of the high-risk occupations, and musculoskeletal disorders are an integral part of this occupation and major farmers suffer from these disorders. The main objective of this systematic review was to rule the Prevalence of Musculoskeletal Disorders and Their Risk Factors among Professional Gardeners. Only 15 studies came under the inclusion criteria. All of them were descriptive studies. The sample group was professional gardener. Results of included descriptive studies were constant and established that repeated activities, carrying large weights, incorrect postures, strenuous work activities are the main risk factor leading to musculoskeletal disorder in gardener. The upper limbs, neck, lower back, and lower limbs are the most important parts of the body that are affected by musculoskeletal disorders. Evidence of high quality in support of this was found in the current review.

It is estimated that work-related illnesses of the musculoskeletal system are responsible for around forty percent of the total compensation paid by employers to employees across the globe (33). According to studies, WMSDs are the cause of more than half of all work absences that occur in the workplace (34). The gardeners use different agricultural tools which have sharp edges so there is a risk of accident while using such tools. Most gardening tools are old-fashioned and need more physical labor to operate. The percentage of accidental injury was found to be 28%. This can be reduced by proper training. (49) It was found that most of the gardening workers involved mainly in spading activity have musculoskeletal disorders. Female agricultural workers suffered discomfort during work, after work and during sleep at night. By considering the results of the study it was revealed that spading is the most strenuous task in gardening. (58) Consistent with previous studies, the current review shows evidence of Digging is a hazardous task when conventional spades are used, ergonomic redesign can reduce the risk of back injury.

The gardeners have to work in different postures continuously for long durations which results in joints pain, swelling, muscle stiffness, and back pain. (59) Current review show evidence that young agricultural workers who are required to constantly bend and twists during work will experience transient fatigue, pain and eventually MSDs. Almost all of the gardening tasks included a gripping position, which may help in maintaining and improving hand strength. Older gardeners had greater hand strength and pinch force than older no gardeners. (24) Current review supported the evidence that older gardeners use body positions during gardening that can provide both health benefits and risks. Biomechanical characterization of gardening through kinematics and kinetics is needed.

One of the primary factors that contribute to the development of WMSDs is prolonged bad posture (37). Workers were exposed to awkward postures, particularly when their limbs, joints, or back were extended in one part, while the other body parts were flexed, bent, or twisted. This caused unnecessary additional force on the joints and amplified the exertion of the tendons and muscles around the affected joints, as more strength was needed to complete the tasks. (60) Inappropriate job postures, which significantly increase their risk of developing work-related musculoskeletal disorders (WMSDs). This puts them at a significantly higher risk of developing WMSDs (39). Current review show evidence that subject suffered discomfort, especially at the wrists, shoulders, hands, lower back and knees. Subjects suffered discomfort during work, after work and during sleep at night The result of regular exposure to work activities that contribute significantly to the development or exacerbation of painful symptoms. Such can be the result of repetitive and frequent work activities resulting in overuse and strain to nerves, ligaments, muscles, tendons, joints, and spinal disc. (61) Other factors that might contribute to the development of these conditions include working in awkward postures, sitting or standing for extended periods of time during shifts, often and daily carrying and movement of heavy items and equipment, excessive force exertion, and so on (38), (36).



The highest prevalence of WMSDs in professional gardener was in the lower back area. Reasons for low back pain in gardeners and landscape workers include incorrect body position, excessive bending, lifting, pulling, and pushing heavy loads many times, long term static work positions as well as severe physical work.(51) Knee pain after back pain ranked second in terms of the prevalence of WMSDs, which can be attributed to excessive knee flexion and high external pressure on the knee when performing work in the knee position. (62) Current review show evidence to contributing factors to musculoskeletal pain and injuries were work practices long Work hours, repetitive work, biomechanical factors (repetitive and sustained work postures, poor manual handling practices) and limited training, ergonomics of the equipment used, fatigue.

Cardio and weightlifting aspects of gardening include tasks like pushing a mower, raking, lifting bags of soil, pushing the wheel barrel, turning compost, shoveling, tiling, and more. The Physical work in gardening is strenuous, so a proper nutritional food supply is must to meet the need of sufficient calories.(63)Current review show evidence that 50% of gardeners are underweight, 31.99% with high normal to high blood pressure, and None with diabetes. Effective ergonomic interventions can reduce the physical demand of manual materials-handling work, thus reducing the chances of musculoskeletal disorders. (64) current review is consistent with the previous literature that shows that Ergonomic interventions can be used as a corrective action and to reveal the problems and effects of musculoskeletal disorders in this group of farmers.

In gardener risk of developing WMSDs in the lower back, knee, and shoulder areas is high, Current review is consistent with the result that Low back pain was the commonest musculoskeletal disorder in gardeners. It was followed Thigh, ankle and neck pain. According to the previous study no significant relationship was found between hours of work activity (8 hours and 10 hours or more) and WMDs, one reason for this could be that fewer people are working more than 8 hours a day than people who are working 8 hours a week in this study.(27)

Conclusion

Thus, gardeners are at increased risk of development of MSD. It may be linked with uncomfortable gardening posture during their work. Lower back, knee, and shoulder areas are mostly effected in gardening. In conclusion, the positions used during gardening can provide both health benefits and risks. In order to utilize gardening as a physical activity for health in older adults, the risks of gardening need to be clearly understood.

Limitation

Furthermore, since this was a cross- sectional study, the information collected and the risk assessment conducted was based on a particular point of time. Hence, there was a constraint in outlining the actual exposure to the various ergonomic risk factors and its subsequent WRMSDs outcomes even though a few observations were conducted and analysed at different points of time.

Recommendation

Future research should investigate specific solutions to address the uncomfortable and dangerous gardening positions to increase the health benefits of gardening.

These types of studies in a large number of subjects from different geographical and economic regions can explore the real picture of professional gardeners, which will definitely help in the betterment of their socioeconomic conditions. In future studies, other ergonomic risk factors should be explored further in each category.



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