TEHRAN UNIVERSITY OF MEDICAL SCIENCES

IJOH INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

2008-5435/14/63-1-8

IRANIAN OCCUPATIONAL HEALTH ASSOCIATION IOHA

REVIEWARTICLE

Risk Factors of Low Back Pain in Iranian Workers during 2000-2015: A Systematic Review

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Received December 25, 2019; Revised August 01, 2020; Accepted August 28, 2020

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

Previous studies confirm direct and indirect costs of low back pain in occupational settings. However, there is no systematic study of the risk factors for low back pain in different occupations; while planning and allocating resources requires comprehensive knowledge at the national and regional levels in order to control and manage low back pain. Therefore, the aim of this study was to identify risk factors of low back pain in Iranian workers during the years 2000 to 2015. Published journal papers, articles presented at the congresses and student thesis reports were systematically reviewed. Abstracts were extracted using appropriate keywords and authentic English-language (Google Scholar, Scopus, and PubMed) and Farsi (Magiran, SID, IranMedex, and Irandoc) databases. Following quality assessment of the selected publications, the full texts of the related ones were reviewed. In 150 eligible studies, the mean prevalence of low back pain in the last 12 months was 48.77. Nordic questionnaire was the most commonly used technique for assessing back pain, and RULA and REBA were the most commonly used method for determining risk factors. All risk factors were categorized into nine groups: biomechanical, workplace design, tools and equipment, environmental, temporal aspects of job design, job content, organizational aspects, personal characteristics, and training. According to the findings, about half of the workers in Iran experienced low back pain. Considering the widespread risk factors and the high prevalence of low back pain among various occupational groups, it is suggested that appropriate measures be taken based on the findings of this study.

KEYWORDS: *Prevalence, Low back pain, Systematic review, Iranian workers*

INTRODUCTION

Seventy to eighty percent of people experience low back pain (LBP) during their lives, and 5-15 percent of them have chronic low back pain (1).

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Low back pain is defined as the pain in the region between hip and thoracic spine; and progressed in less than 6 months (2). Low back pain, after headache, is the second prevalent pain among American workers (3). In Europe, 30% of workers' population, approximately 44 million workers, suffer from LBP.

In Greece, 44% of working population suffer from occupational LBP (4). LBP is the second most common cause of disability in the US, exceeded only by arthritis and rheumatism. Sixty to seventy percent of American population experience an episode of low back pain during their personal lives; and 25-30% of them asked for medications (2).

A survey in the United States showed that 13% of the total workforce experienced a loss in productive time during a 2-week period due to a common pain condition. Of this 13%, 3.2% reported lost productive time due to back pain (5). In 1998, direct healthcare costs related to LBP in the USA was calculated almost 26.3 billion dollars. Besides, indirect costs related to days lost from work are extensive, with approximately 2% of the U.S. work force requested for compensation due to back injuries each year. Moreover, about 5% of the people with back pain disability account for 75% of the costs related to LBP (6). The annual loss of 600 million working days, reduced productivity, the financial compensation of injured workers, and the cost of employing and training new staff are just some of the consequences of low back pain (4).

In Iran, according to report of the Medical Commission of the Social Security Organization of Tehran Province, 14.4% of disability due to various diseases is related to musculoskeletal disorders; and LBP is the second reason for work absenteeism, the third reason for physician visits, and the fifth reason for being hospitalized (7).

Risk factors related to low back pain can be classified into various categories including physical, psychosocial and lifestyle/personal risk factors (age, weight, physical activity, and physical disability) (8). Risk factors related to the physical work environment consisted of high work pace, repetitive movement patterns, insufficient recovery time, heavy lifting, high hand force, asymmetrical body postures (dynamic or static), mechanical pressure, vibration (local or total body), and low ambient temperature (9-11). In a study conducted by Punnett et al. (2005), on the estimation of global burden of LBP attributed to a combination of job exposures, it was reported that 37% of all LBP attributed to occupation. What is more, the attributable proportion was higher in men than women due to their greater involvement in the in occupations with heavy manual handling or whole-body vibrations (9).

Several previous studies have identified risk factors of LBP according to occupational groups. For example, drivers' LBP have been mainly attributed to long hours of driving in a limited posture, vibrations, and mental workload (12). In a study by Ogunbode et al. (2013), activities such as lifting, bending, and static postures for more than 3 hours were found to be in association with LBP in nurses (13). In another study, chronic LBP in nurses was associated with flexion/extension activities, back rotation, pushing, pulling, manual carrying, patient movement, and sitting (14). Spyropoulos et al. (2007) reported gender, age, BMI, horizontal distance between body and monitor, adjustability of back support, prolonged sitting (more than 6 hours), slumped posture, job satisfaction, repetitive task and anger during last 30 days as the main risk factors contributing to prediction of LBP among office workers (4).

Despite the importance of the above-mentioned issues, there is paucity of systematic study in Iran on low back pain risk factors categorized by occupations. Strategic planning and resource allocation to control and manage occupational LBP requires this information. Furthermore, knowledge of LBP prevalence as well as types of its risk factors will be of great importance in determining intervention priorities in national programs. In this regard, this study was aimed to survey occupational risk factors related to LBP in Iranian working population from 2000 to 2015.

METHOD

The present retrospective study is conducted to determine the risk factors affecting LBP among Iranian workforce. Therefore, the study population consists of all the present articles that their participants were working in various industries in Iran. In order to gather data, all the available published journal papers, articles presented at the congresses and student thesis reports were systematically reviewed. A search of main databases (Google Scholar, Scopus, PubMed, Magiran, SID, IranMedex, and Irandoc) were conducted up to January 15th, 2017 for articles pertaining to low back pain and its risk factors, published during 2000–2015. Our search strategy was applied to all databases in a similar manner and included four groups of keywords to fulfill various aspects of our review: 1) the

Published online: September 30, 2020

outcome ("prevalence", "musculoskeletal disorders", "low back pain", "back pain"), 2) the study population ("Iranian workers", "Iran", "personnel", "occupational setting"), 3) exposure ("risk factors", "ergonomics", "ergonomics risk factors"), 4) "ergonomics evaluation", "assessment technique" "assessment"). Boolean operators (AND, OR) were used to combine search terms in all databases. In addition, the reference lists of papers, which met the inclusion criteria, were reviewed to identify additional studies not included in the electronic search.

Retrieved articles were screened based on their titles and abstracts for relevance by two independent reviewers. After removal of duplicates, the same two reviewers prepared and assessed full text versions of relevant publications for eligibility and quality based on determined inclusion criteria. In case of having any conflicts, a third reviewer checked the articles and decided whether it was qualified or not. The level of agreement between the two researchers' quality assessment was estimated 0.7 by Kappa. Studies were included if they had the following criteria: 1) samples involving workers of various occupations with at least 6 months' work experience in their current job; 2) samples with no history of injury/diseases 3) reporting LBP prevalence; and 4) reporting LBP risk factors. Studies with low numbers of observations and those related to non-occupational sample groups were excluded from this study. An excel sheet was prepared as a guide to extract data including: search engine, source (article, thesis, conference), type of article (cross sectional, case study, cohort, etc.), year of publication, target group, number of subjects based on gender (%), type of sampling (random, systematic, convenience, cluster, and stratified), mean (SD) of age, body region, inclusion/exclusion criteria, method of LBP assessment, and the method of risk factors identification. Data extraction was done blinded to authors and the journal. All extracted data was encoded and then entered into the SPSS software.

Due to the diversity of occupations extracted from publications, they were categorized into eight groups according to International Standard Classification of Occupations (ISCO-08) (15): industry, office, health, handicraft, services, agriculture, music, and education. Risk factors of LBP were also categorized into eleven groups consisting of: biomechanical, workplace design, tools and equipment, environmental, temporal aspects of job design, job content, organizational, personal characteristics, and training-related risk factors.

RESULTS

The search yielded 747 articles. Figure 1 represents the flowchart of inclusion in this study. After duplicates removal (n= 305), the remaining 422 articles were screened based on their title and abstract. Full-texts of 197 articles were investigated. Finally, 151 articles were included in the present review.

According to the results, 25.9% of the studies were conducted in 2011 and 19.3% were published in 2013. Moreover, 96.7% of the studies were cross-sectional. Regarding the percentage of publications based on search engine, results showed that 78.7% were extracted from google scholar. What is more, 98.7% of the extracted publications were articles published in prestigious national and international journals.

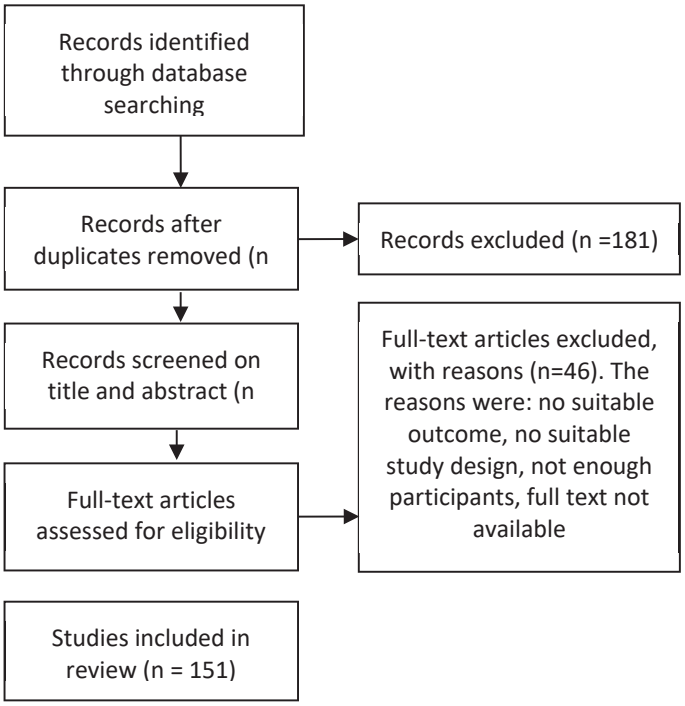

Fig 1. Flowchart of study screening process in the present systematic review for investigating LBP prevalence and risk factors

Due to the wide range of occupations extracted from the included publications, jobs were classified in eight groups including: industry (workers in car manufacturing, production unit, welding, foundry, battery making, mining, construction, assembly, glass industry, manual handling, furniture factory, dairy factory, generator manufacturing, date packaging, petrochemical/oil, heavy metals, stonecutting and mining, parts manufacturing), office (computer users, Archivist, bank employee, receptionist, medical recorders, librarian, office worker), health (nurse, operating room staff, midwife, dentist, surgeon, physician, pharmacist, ultrasound specialist, laboratory staff, rehabilitation center staff, orthotics and prosthesis staff, emergency personnel), handicrafts (carpet weavers, darners, marquetry workers), services (chef, cooking staff, baker, tailor, shoemaker, driver, firefighter, hairdresser), agriculture (saffron harvesters, paddy farmers, milkmaids), music, education (teacher/professors). The results showed that 41% of all participants were workers in industrial occupational group followed by workers in health sector (28%).

Considering the risk factors for LBP, all the reported risk factors were classified into nine groups including: biomechanical (32 components), workplace design (12 components), tools and equipment (19 components), environmental-related (7 components), temporal aspects of job design (6 components), job content (19 components), organizational aspects (5 components), personal characteristics (18 components), and training (5 components).

The average prevalence of LBP based on various occupational groups is shown in Table 9. As it can be seen, the highest prevalence of LBP is pertained to agriculture (58.22%) and handicrafts (58.88%), respectively, and the lowest is related to music (18.50%).

Nordic Questionnaire Assessment (NMQ) technique was the most commonly used method for determining LBP prevalence, which was used in 76.2% of the whole publications. Regarding risk factor

identification method, two techniques, RULA (13.9%) and REBA (13.8%) obtained the highest scores. The proportion of each of the nine classified risk factor are given in Tables 2 to 10.

Table 1. Prevalence of LBP in the past 12 month among workers in categorized occupational groups

Occupational group	Min.	Max.	Mean	SD.
Industry	5.00	93.0	48.6	21.42
office	14.49	93.0	47.46	22.9
Health	11.1	75.6	46.22	16.9
Handcrafts	29.2	80.0	58.08	21.79
Services	12.7	96.0	54.9	19.31
Agricultur	21.0	81.5	58.22	23.83
Music	18.50	18.5	18.5	0
Education	41.0	62.2	51.6	14.99

Table 2. Percentage of "biomechanical risk factors" category based on occupation group

Risk factor	Industry	Office	Health	Handicrafts	Services	Agriculture	Music	Education
Awkward posture	51.7	28.6	45.2	-	35.7	20	100	-
Joints at the end or near the end of the range of motion	3.3	-	-	-	-	-	-	-
Neck awkward posture (flexion and twisting)	3.3	-	4.8	-	-	-	-	-
Prolonged neck flexion	-	4.8	-	-	-	-	-	-
Repetitive neck lateral bending	-	4.8	2.4	-	-	-	-	-
Trunk awkward posture (extrmre flexion or twisting, simultaneous flexion and twisting)	8.3	-	9.5	25	14.3	80	-	-
Prolonged flexed or twisted trunk posture	1.7	-	4.8	-	-	-	-	-
Lumbar injuries	-	-	-	-	14.3	-	-	-
Wrist awkward posture (flexed/deviated/twisted wrist)	10	-	2.4	-	-	-	-	-
Repetitive wrist motions	-	-	2.4	-	-	20	-	-
Trigger motions	1.7	-	-	-	-	-	-	-
Static posture and prolonged static contraction	6.7	9.5	4.8	-	-	-	-	-
Arms away from trunk (being in abduction)	3.3	-	2.4	-	-	-	-	-

Kneeling	-	-	-	25	-	-	-	-
Static posture	3.3	19	9.5	-	-	-	-	-
Working above shoulder height	1.7	-	2.4	-	-	-	-	-
Rapid motion and twisting in spine	-	-	2.4	-	-	20	-	-
High weight of loads	15	4.8	9.5	-	14.3	40	-	-
Long distance between load and body while manual handeling	-	-	-	-	7.1	-	-	-
Load displacement height	3.3	-	-	-	7.1	-	-	-
Repetitive activities with high frequencies	15	4.8	14.3	-	-	20	-	-
Prolonged sitting	10	19	4.8	-	21.4	-	-	50
Prolonged standing	20	-	4.9	-	21.4	20	-	-
Manual handeling (lifting, unloading, pulling, pushing)	30	4.8	14.3	25	21.4	40	-	-
Squat posture due to limited space and applying too much force	6.7	-	2.4	-	-	-	-	-
Repetitive load lifting	6.7	-	-	-	7.1	40	-	-
Patient lifting	-	-	16.7	-	-	-	-	-
Duration of exposure	3.3	-	4.8	-	7.1	-	-	-
Use of mechanical levers	-	-	-	-	7.1	-	-	-
Consecutive physical and mechanical stresses	-	-	-	-	-	-	-	-
Postural strain	3.3	-	2.4	-	-	-	-	-

Published online: September 30, 2020

Table 3. Percentage of risk factors related to "workplace design" category based on occupation group

Risk factor	Industry	Office	Health	Handicrafts	Services	Education
Inappropriate layout	5	-	2.4	-	-	-
Mismatches between workstation and worker stature	-	-	4.8	-	-	-
Inadequate space	1.7	-	2.4	-	-	-
Lack of cleanliness	3.3	-	-	-	-	-
Disorganization in the workplace	1.7	-	-	-	-	-
Limited and enclosed space	1.7	-	-	-	-	-
Uneven and hard surfaces	1.7	-	-	-	-	-
Unadjustable work surface height	3.4	-	-	25	-	-
Lack of ergonomics intervention in the work place	-	4.8	-	-	-	-
Limit space for knees	1.7	-	-	25	-	-
Designing workplace based on young workers anthropometrics dimensions	1.7	-	-	-	-	-
Inappropriate workplace/workstation design	9.4	20	12.5	-	12.5	50

Published online: September 30, 2020

Table 4. Percentage of risk factors related to "tools and equipment" category based on occupation group

Risk factor	Industry	office	Health	Handcrafts	Services	Education
Unadjustable workstation equipment	1.7	-	2.4	-	-	-
Non-ergonomics tools	6.7	4.8	9.5	50	-	-
Lack of holder	-	-	-	25	-	-
Non-ergonomics chair	3.3	4.8	4.8	-	-	-
Lack of trollys/ patient lifter	-	4.8	-	7.1	-	-
Lack of lifting equipment	-	-	2.4	-	-	-
Mismatches between chair back support and lumbar region	-	4.8	-	-	7.1	-
Mismatches between work desk height and chair	-	4.8	-	-		50
Mismatches between popliteal-bottock length and and seating depth	-	-	2.4	-		50
Inappropriate popliteal height	-	-	2.4	-	-	50
Inappropriate work desk/workstation	-	-	2.4	-	7.1	-
Inappropriate car feature	-	-	-	-	7.1	-
Inappropriate/non-standard tools	1.7	4.8	-	-	-	-
Lack of arm-rest/not using arm-rest	-	-	2.4	25	-	-
Mismatches between tools and workder anthropometric dimensions	1.7	-	-	-	-	-
Unadjustable chair and work desk	1.7	-	-	-	-	-
Non-ergonomics seating	-	-	-	-	1.7	-
Unrotatable chair	1.7	-	-	25	-	-

Published online: September 30, 2020

Table 5. Percentage of "environmental risk factors" category based on occupation group

Risk factor	Industry	office	Health	Handcrafts	Services
Poor lighting	1.7	4.8	2.4	25	-
Humid weather	-	-	2.4	-	-
Vibration	1.7	-	2.4	-	14.3
Unfavorable humidity	-	-	2.4	-	-
VDT effects	-	-	2.4	-	-

Table 6. Percentage of risk factors related to the "temporal aspects of job design" category based on occupation group

Risk factor	Industry	office	Health	Handcrafts	Services	Agriculture
Prolonged shifts	6.7	9.5	-	25	21.4	-
Having no/little rest	8.3	9.5	7.3	25	21.4	20
Task duration	1.7	-	2.4	-	-	-
Prolonged working hours	-	-	2.4	-	-	-
shift working program	1.7	-	7.1	-	-	-
Prolonged working hours in a working week	-	-	4.8	-	-	-

Published online: September 30, 2020

Table 7. Percentage of risk factors related to "job content" category based on occupation group

Risk factor	Industry	office	Health	Handcrafts	Services
Occupational stress	6.7	9.5	9.5	-	7.1
the way to do the work	-	-	-	25	7.1
Workload (for example: number of rows of knitting in one day, type of work task / number of scans per week / distance traveled or driving time)	1.7	9.5	-	-	-
Mismatches between work and its physical characteristics	-	-	4.8	25	7.1
Mental tension	1.7	-	-	-	-
Lack of task diversity	-	-	7.1	-	-
Heavy workload	-	4.8	2.4	-	-
Work-related fatigue	-	4.8	-	-	-
Static works without rotation	1.7	-	-	-	-
Lack of authority	-	-	2.4	-	-
Unhealthy competition	1.7	-	2.4	-	-
Heavy responsibility	-	-	2.4	-	-
No control over work pace	-	-	2.4	-	-
Nature of tasks	2.4	4.8	-	-	-
Prolonged duration of working with PC	1.7	9.5	-	-	-
Lack of job satisfaction	-	4.8	-	-	-
Occupational tension	1.7	-	-	-	-
Physical/mental workload	1.7	-	4.8	-	-

Published online: September 30, 2020

Table 8. Percentage of risk factors related to "organizational aspects" category based on occupation group

Risk factor	Industry	office	Health	Services
Requiring management control	-	-	2.4	-
Ratio of nurses per bed	-	-	4.9	-
Inadequate number of staff/having no assistance/ accomplishing demanding task alone	1.7	-	5	-
Lack of proper job rotation	-	-	-	7.1
Unhealthy behaviors in the workplace	-	4.8	-	-

Published online: September 30, 2020

Table 9. Percentage of risk factors related to "personal characteristics" category based on occupation group

Risk factors	Industry	Office	Health	Handicrafts	Services	Agriculture
Marital status	3.3	-	2.4	25	-	-
Gender	11.7	9.5	19	25	7.1	-
Work experience	15	19	21.4	50	7.1	40
BMI	8.3	4.8	11.9	25	7.1	-
Physical activity	8.3	14.3	-	-	-	20
Stature	3.3	-	7.1	-	-	20
Weight	5	-	7.1	-	-	20
Prominent hand (right-handed)	3.3	-	-	-	-	-
Second job	-	4.8	2.4	-	-	-
General health status	-	-	-	-	7.1	-
Smoking habit	5	-	4.8	-	-	-
Drinking habit	-	-	2.4	-	-	-
Number of cigarette per day	-	-	2.4	-	-	-
Type of employment	-	-	2.4	-	-	-
Level of education (people with lower level of education involved in more operational jobs)	3.3	-	2.4	25	-	-
Sleeping supine posture	1.7	-	-	-	-	-
Depression	2.4	-	-	-	-	-
Age	16.4	9.5	9.5	50	14.3	20

Published online: September 30, 2020

Table 10. Percentage of risk factors related to "training" category based on occupation group

Risk factors	Industry	Office	Health
Inadequate knowledge regarding patient lifting	-	-	2.4
Staff inadequate knowledge	3.3	4.8	9.5
Neglecting ergonomics principles	1.7	4.8	-
Inadequate knowedge regarding proper posture	3.3	4.8	4.8
Inadequate knowedge regarding proper equipment usage	-	9.5	4.8

DISCUSSION

LBP and its associated costs are considered as a growing issue in modern society. In the eyes of experts in the occupational health field, LBP is workers' main problem. Following headache, LBP is the second reason for experiencing pain, which its adult incidence is reported to be 5% per year. In Britain, LBP is the main reason of sick leaves among workers and in Sweden, it is one of the main reasons for worker's disability and frequent requests of days off from work. Despite the advances in medical sciences, LBP is still one of the prevalent disorders and disabilities among people under 45 years old (16-18). The Canadian Occupational Health and Safety Association has stated that poor posture, repetitive movements, excessive use of force at work, prolonged standing and long shifts are the most important factors influencing discomfort (14). Present study was conducted to assess the risk factors of occupational LBP identified in previous published studies between 2000 and 2015. According to the findings, 96.7% of the studies had cross-sectional design. Moreover, 25.9% of the investigated studies were conducted in year 2006 and 19.3% were published in year 2008. A large percentage of the studies were articles published in prestigious national and international journals.

Due to the wide range of extracted occupations, they were classified into eight groups including industry, office, health, handicrafts, services, agriculture, music, and training. According to the results, 41% of all participants were workers in industry. The second prevalent occupation was belonged to those workers in health settings (28%).

All the LBP risk factors reported in the previous studies were extracted and classified into nine groups including biomechanics, workplace design, tools and equipment, environmental, temporal aspects of the job, job content, organizational aspects , personal characteristics, and training (14, 19).

Overall, the mean prevalence of LBP in the last 12 months for the 150 eligible studies between 2000 and 2015 was estimated 48.77, nearly half of the employees. Through searches in national and international databases, it was revealed that no systematic review or meta-analysis in Iran were conducted in order to compare their results with the findings of the present research. Most of the studies were focused on all the population not the working group.

So far, various systematic studies have been conducted on the prevalence of LBP and it is shown that its prevalence is increasing over the coming decades (20, 21). In this study the average of LBP prevalence among workers in various occupations were calculated. Based on the results, workers in agriculture category accounts for the highest level of LBP (58.22%), followed by handcrafts (58.08%). Music-related occupations had the lowest level of pain in the lumbar region (18.50%). A study in United States revealed that low back pain is a common

disorder among farmers and the portion of men suffering from is higher than females. In another study which was done with the aim of LBP comparison in different jobs it was observed that female nurses experienced LBP more severe than their men counterparts (22, 23)

With respect to the various method of LBP assessment technique in the selected studies, Nordic questionnaire were the most frequently used assessment method. In the study by Soroush et al. (2018) to determine the prevalence of MSDs among Iranian it was shown that out of 41 selected articles, 38 articles used the Nordic Questionnaire (24).

RULA and REBA considered as the most preferable technique in risk factors identification. Similarly, in the systematic review of risk assessment techniques of musculoskeletal disorders by Pandya and Desai (2019), it was revealed that RULA and REBA were amongst the most commonly used techniques (25). Of the main advantages of these observational techniques are being low cost, ease of use, and assessing a wide range of risk factors and body postures (26).

The percentage of identified risk factors including biomechanical, workplace design, tools and equipment, environmental, temporal aspects, job content, organizational aspects, personal characteristics, and education was calculated. Considering biomechanical risk factors in industry, 51.7% of studies mentioned that awkward posture was the main reason for LBP. Among office workers, awkward posture (28.6%), prolonged sedentary posture (19%) and prolonged static tasks (19%) were the most hazardous risk factors. In health section, inappropriate posture (45.2%) and patient lifting (19%) were known as the main LBP contributor. Awkward upper extremities posture, trunk twisting/flexion or simultaneous twisting and flexion in trunk (25%), kneeling (25%) and manual handling (25%) were the main contributing risk factor in LBP developments in workers in handcraft field. In a study on 3920 workers, truck driving, lifting, carrying, pushing, pulling, twisting and working with vibration machines were identified as LBP risk factors (27).

Awkward posture was responsible to 35.7% and 80% of LBP in agricultural and services fields, respectively. Finally, in education group prolonged sitting was the main risk factor (50%). The results of a study on crane drivers, lift drivers and office workers exposing to prolonged sitting showed that inappropriate postures while sitting are among the main causes of occupational back pain (28). However, Hartvigsen study showed no association between prolonged sitting and employees back pain (29). Chen et al. (2009) identified the adverse effects of sitting for long durations as weakness of lumbar structures, increased spinal loads, and reduction of metabolic exchange (30). Corlett (2006) suggested that prolonged sitting could be a risk factor for developing LBP (31).

Considering risk factors related to workplace design, in industry (9.4%), office (20%), health (12.5%), services (12.5%), and educational (50%) groups, improper workplace design/improper workstation has been identified as the most common cause of low back pain. In order to identify the risk factors related to tools and equipment, findings showed that in industrial sector (6.7%), health (9.5 %), and handicrafts (20 %), non-ergonomic tools were the most common risk factor. In office sector, non-ergonomic tools, unsuitable chair (non-ergonomic chair), mismatches between back seat with the lumbar region of worker, and mismatch between table height and chair had obtained similar proportion of 4.8% in development of low back pain.

In service sector, the risk factors including mismatches between back support and lumbar region, inappropriate work desk/workstation, and inappropriate car features have also had an equal contribution in LBP (7.1%). For education sector employees, the most important risk factors were: mismatches between desk height and chair, mismatches between popliteal-buttock length and seat depth, inappropriate popliteal height (50%).

In the environmental-related category, poor lighting (1.7%) and vibration (1.7%) were the most important risk factors. In the office and handicraft sectors, the risk factor of poor lighting with percentages of 4.8 and 25, respectively, was significant.

In the service sector, vibration ranked first with 14.3 percent. Among health care workers, all risk factors including poor lighting, humid climate, vibration, poor humidity, and the effects of VDT had an equal share. In service sector, vibration ranked first with 14.3%. For health care workers, all risk factors including poor lighting, humid climate, vibration, poor humidity, and the effects of VDT had an equal

contribution. Regarding the temporal aspects of job design, the findings showed that in all job groups, short rest time/insufficient intervals accounted as the main risk factor in this field.

In the category of job-related risk factors, in industrial sector (6.7 percent) and in health care sector (9.5 percent), work stress was identified as the most important risk factor. In office sector, work stress, repetitive work, and prolonged working with PC (with 9.5 percent) contributed equally to low back pain. In the service sector, work stress, the way to do work, and workload (such as the number of rows of knitting in a day, the type of task/the number of scans per week/distance traveled), driving time (with equal percentages of 7.1) play an equal role in causing low back pain.

The most important organizational risk factors in industrial sector was the lack of workforce/inadequate number of staff/doing heavy work alone (1.7%), and in office sector, unhealthy behavior in the workplace (4.8%). In health care sector, there was a shortage of workforce/inadequate number of staff (not using assistants)/heavy work alone (5%), and no rotation program (7.1%). According to personal characteristics, in industries, the age (16.4%) and work experience (15%) obtained first and second ranks in LBP.

In the office section, work experience (21.4%) and physical activity (exercise)/sedentary posture/physical fitness (14.3%) were the most important risk factors. The two variables of work experience (21.4%) and gender (19%) were the most important individual risk factors in the health care sector. Work experience and age (with 50%) were recognized important in the handicrafts sector.

In agriculture and music sectors, the age was also identified as a personal-related factor affecting LBP. Finally, in the education sector, in industry, office, and health groups, the lack of knowledge was recognized as a substantial variable. Regarding the effect of education, a study in Malaysia stated that lack of ergonomic training courses and not having basic knowledge about ergonomics in the workplace play an important role in occupational back pain (32)

In general, various factors introduced in previous studies, were classified in the present research and the most important risk factor in each category were identified. Due to the wide range of identified risk factors as well as the high prevalence of low back pain in different occupational groups, it is recommended that appropriate measures should be adopted based on the findings of this study. The results of this study also provide a clearer picture to control risk factors and will be beneficial in optimal allocation of resources to control LBP in workplaces.

Regarding the limitations of the present study, it should be noted that there was difficulty to access full-text of some original articles, resulting in not being considered in this study. Another limitation was the lack of a regular framework for reporting results and considerable methodological heterogeneity in the published articles in Iran. Therefore, the results were only reported descriptively. Moreover, search operators are not compatible with some national databases so maybe some researches were done in Iran but they do not include in the search results.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

ACKNOWLEDGMENT

The authors appreciate Center for Research on Occupational diseases, Tehran University of Medical Sciences for funding this project with grant no. 95-01-109-31731.

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Published online: September 30, 2020

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Published online: September 30, 2020