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ORIGINAL RESEARCH

Assessment of the prevalence and risk factors of low back pain in operating room health workers: An observational study in Italy

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Abstract

Aim: The aim of this study was to assess the prevalence of low back pain (LBP) among health professionals and the possible risk factors.

Methods: The study was carried out from April 2018 to October 2018 among all health workers of the Orthopaedic Clinic and the Emergency Department of *"Policlinico Umberto I"* in Rome. LBP was assessed using the *Nordic Questionnaire Musculoskeletal Disorders* in the section on lumbar pain. The type of physical activity carried out as prevention was investigated by use of the *International Physical Activity Questionnaires.* The overall state of health and lifestyle was determined by the *Short Form 12-item Health Survey*. Job satisfaction and perceived work stress were assessed through the *15-questions of Karasek's Questionnaire.* The intensity of the low back pain was assessed using a *Numerical Rating Scale*. A univariate analysis was conducted to assess the associations between socio-demographic and working variables. Multiple logistic regression models were used to assess independent correlates of LBP.

Results: One hundred thirteen subjects were enrolled, 52 women and 61 men. The annual period-prevalence of lumbar musculoskeletal disorder was found on 79.6% of participants with LBP. Mean value evidence of NRS was 2.66. The highest LBP risk over the 12 months was found in groups with high job demand (OR = 1.18; 95%CI: 1.01 – 1.38), low decision-making opportunities (for decision latitude OR = 0.87; (0-76 – 1.0), and low levels of physical activity (OR = 0.75; 95%CI: 0.64 – 0.89).

Conclusion: The working environment is a potential risk factor for the development of LBP and is suitable for prevention programmes. The protective effect of physical activity and work-related stress management indicate room for improvements for the prevention of LBP in these HCWs.

Keywords: *health workers, low back pain, occupational low back pain, operating room health professionals, prevention.*

Conflicts of interest: None declared.

Introduction

Low back pain's incidence in adult population is 10-30% every year and the lifetime prevalence in adults is as high as 65-80% in USA (1,2). People in working age, from 26 to 60 years, are affected by low back pain at least once in their lifetime (3). Occupational Low Back Pain (LBP) has become an emerging health issue in recent years (4,5). In Italy a review found that LBP prevalence in healthcare workers varied from 33% to 86% (6).

Among health care workers, nurses and surgeons are the working categories with the highest risk of experiencing pain related to musculoskeletal disorders (MSDs) during their working life. This risk is related to a broad range of factors such as incorrect postures, exposure to heavy physical loads, muscle strain, whole-body vibrations (WBV), patient treatment activities (3,7-10) and may affect the ability and the efficiency of health care workers in the performance of their tasks (10).

Awkward postures, carrying and repositioning patients, prolonged standing, and working without sufficient breaks represent risk factors for the developing of LBP in nurses (11).

Among physicians the prevalence of LBP is higher among surgeons (37%) than other specialties (9,12,13). The inappropriate positioning, posture during surgery, and prolonged standing are possible cause (14,15).

Persistent low back pain comes along with several consequences and can cause temporary work disability with sick leave (16). Work-related MSDs are the number one cause of absenteeism among the health care workers. The US Department of Labor estimates that MSDs are the cause of 62% of all worker injuries and 32% of missed days from work, and an estimated economic impact of $13 to $20 billion every year (9).

It is essential to promote new prevention programmes based on vocational training and physical activity to provide benefits and reduce the incidence of LBP in these professional categories since it's been demonstrated that muscle strength is a protective factor against physical fatigue and MSDs (12,17).

Due to the prolonged activity and the burden of workload on spine and shoulders of operating room health workers, as detected during the occupational health visit, the aim of the study was to assess the prevalence of LBP related to the work activity in a group of health workers, from the Orthopaedic Clinic and the Emergency Department, and the associated risk factors.

Methods

This observational study was led by the Pain Therapy Center "Enzo Borzomati" – Hub Lazio region, in collaboration with Occupational Medicine and Medical Radiation Protection Service of the University Hospital "Umberto I" in Rome. Approval to conduct this study was obtained from the Ethical Committee of our University Hospital (5030/18). All study participants gave informed written consent and the research was conducted in accordance with the Helsinki Declaration.

Data were collected from April 2018 to October 2018 among health workers of the Orthopaedic Clinic and the Emergency Department of "Policlinico Umberto I" in Rome Participation in the study was voluntary and anonymous.

Setting and population

All healthcare professionals who were working in the operational unit of Orthopaedic surgery and Emergency department (DEA) at

the "Policlinico Umberto I" in Rome (Italy) were invited to participate. They were approached by telephone and an appointment for the interview was fixed.

Admission criteria: i) healthcare professionals in the operational unit of Orthopaedic surgery and Emergency surgery; ii) candidates of both sexes and over the age of 18 and under 70 years old.

Exclusion criteria: i) participants in other studies; ii) subjects with serious local or systemic physical occurring pathologies that can interfere in the investigator's judgment with pain assessment; iii) subjects with recent surgical procedure.

Data collection

Data were collected using standardised validated questionnaires in Italian. The presence of low back pain was assessed using the Italian version of the *Nordic Questionnaire Musculoskeletal Disorders* in the section on lumbar pain (18,19).

The type and quality of physical activity carried out as prevention and/or therapy has been investigated with *International Physical Activity Questionnaires (IPAQ*) (20,21).

The overall state of health and lifestyle was determined by *Short Form 12-item Health Survey (SF-12 standard V1)* (22-23). Job satisfaction and perceived work stress were assessed through the 15-questions Karasek Questionnaire (24). The intensity of the low back pain was assessed using a *Numerical Rating Scale (NRS*) (25).

Statistical analysis

Quantitative and qualitative variables were examined and their frequency was calculated: years of work, years of work in the company ("Policlinico Umberto I" University Hospital in Rome), type of permanent/occasional contract with continuous/split hours and fixed/rotation on several shifts.

Particular attention was paid to the Body Mass Index (BMI, calculated considering the weight and height of the subject under examination) and the hours of work spent standing or sitting.

A univariate analysis was conducted to assess the association between socio-demographic factors and working variables with the following variables derived from the *Nordic Questionnaire Musculoskeletal Disorders:*

- Have you ever had low back pain disorders in the last few months?
- During the last 12 months, have your musculoskeletal disorders ever prevented you from performing your normal activities both at home and outside?
- Have these disorders manifested themselves in the last seven days?
- Have you ever had any lower back problems in your life?
- Have you ever suffered any lower back trauma as a result of an injury?

Logistic regression models have been built for the variables "*Lumbar pain in the last 12 months*" and "*Lumbar pain in the last 7 days*" in order to verify the associated variables with a multiple regression approach. We built full model and stepwise models with a backward elimination procedure. The results are presented as Odd Ratio (OR) and 95% Confidence Interval (95%CI). Goodness of fit of the models was assesses using the Hosmer-Lemeshow test. The level of significance was set at $p \leq 0.05$. The SPSS statistical package, version 25.0, was used.

Results

One hundred thirteenhealth professionals (response rate 100%) completed the study.

Contingency tables have been elaborated to describe and analyse the relationships between two or more variables and to define the frequency tables, the results of which have

been graphically represented by histogram, box-plot, dot-plot.

Socio-demographic and clinical data were obtained by the Nordic Questionnaire Musculoskeletal Disorders, in relation to the lumbar section, which were identified as quantitative and qualitative variables associated with LBP.

52 women (46%) and 61 men (54%), were enrolled, aged between 26 and 68 years (average age = 42.76 years, St. Dev. = 12; median = 44 years; mode = 29 years).

Participants were divided into different groups on the basis of qualification and recoded as follows:

- specialist medical surgeon: No. 18/113 - 15.9%;
- specialist medical personnel: n° 33/113 - 29.2%;
- nursing staff: No. 49/113 (4 nursing coordinators, 44 nurses) - 43.4%;
- technical operator (OT): n° 7/113 - 6.2%;
- socio-medical caregiver (in Italian medical system distinguished in two professional figures having ASS and OSS as acronyms) and technical caregiver (in Italian medical acronyms OTA): n° 6/85 (3ASS, 2OSS, 1OTA) - 5.3%.

Table 1 shows the characteristics of the study participants.

Out of 113 subjects examined:

- 111 subjects have permanent employment and only 2 occasional;
- 107 subjects have a full-time job and 6 subjects have a part-time job;
- 14 subjects work the morning shift, 39 in the morning and afternoon, 36 work the multi-shift rotation.

Table 1. Characteristics of the study participants

Variable	N (%) or Median (range)
Gender	
Female	52 (53.8)
Male	61 (68.9)
Age	44 (26 – 68)
Years of work	11.4 (0.3 – 40.3)
Hours of work standing up	6 (3-10)
Hours of work sitting	1.5 (0-20)
Continuous working hours	
No	12 (66.7)
Yes	101 (61.4)
Job role	
Nurses	49 (51)
Other health professions	6 (83.3)
Technicians	7 (57.1)
Doctors in training	33 (66.7)
Structured doctors	18 (77.8)
BMI (Body Mass Index)	24 (18.1 – 36.2)
MET (Metabolic equivalent of task)	3483 (0 – 79140)
PCS (Physical Component Summary)	49.5 (24.5 – 63.7)
MCS (Mental Component Summary)	46.4 (20.1 – 62.8)
Low back pain	
Lifetime	99 (87.6)
In the last 12 months	90 (79.6)
In the last week	43 (38.1)
Decision latitude	68 (52 - 90)
Job demand	35(25 – 48)
Job strain	0.82 (0.49 – 1.29)

Based on the analysed data, it was possible to calculate the prevalence of LBP with time intervals of one week, one year, over a lifetime and the percentage of subjects who have never had LBP experience.
Subsequently, the annual periodic prevalence of lumbar musculoskeletal disorder was quantified on the total of 79.6% of subjects with LBP.

The intensity of lumbar pain in the last 7 days was evaluated using the Numerical Rating Scale (NRS) with a mean value evidence, on a scale from 0 to 10, of 2.66.
A predictive factor for persistent low back pain seems to be the presence of neuropathy in the lower limbs, with an incidence of 11.7% on the lifetime prevalence of LBP (Table 2).

Table 2. Lumbar pain in the last 12 months

Variable	NO	YES	P
Gender			
Female	9 (17.3)	43 (82.7)	0.458
Male	14 (23)	47 (77)	
Age	47 (27 – 68)	43.5 (26 - 64)	0.343
Years of work	10 (0.3 – 40)	12 (0.3 – 40.3	0.795
Continuous working hours			
No	5 (41.7)	7 (58.3)	**0.05**
Yes	18 (17.8)	83 (82.2)	
Job role			
Nurses	12 (24.5)	37 (75.5)	
Other health professions	1 (16.7)	5 (83.3)	
Technicians	1 (14.3)	6 (85.7)	0.914
Doctors in training	6 (18.2)	27 (81.8)	
Structured doctors	3 (16.7)	15 (83.3)	
BMI	23.4 (18.1 – 36.2)	24 (18.2 – 36.2)	0.559
Job strain	0.79 (0.59 – 1.01)	0.82 (0.49 – 1.29)	0.290
MET	2670 (495 - 17790)	3483 (0 - 79140)	0.392
MCS	48.3 (20.6 – 58.8)	48.8 (22.1 – 63.9)	0.746
PCS	55 (34.1 – 63.3)	50.6 (23.8 – 61.2)	< **0.001**

Legend: BMI= Body Mass Index; MET = metabolic equivalent of task; MCS =Mental Component Summary; PCS =Physical Component Summary

The 15-question Karasek questionnaire provided data on psychosocial conditions at work and perceived work stress, i.e. it was possible to assess the worker's autonomy in making decisions concerning his or her job. This model suggests that the relationship between high job demand (job demand, JD) and low decision-making freedom (decision latitude, DL) defines a condition of "job strain" or "perceived job stress", which can explain

- taxing nature of the organization;
- number of working hours;
- any inconsistent requests.

the levels of chronic stress and the increased risk in this case of manifesting LBP (Table 3).
The two main working dimensions (JD vs DL) are considered independent variables and placed on orthogonal axes.
The job demand refers to the work effort required, in terms of:

- work rhythms;

Decision latitude, on the other hand, is defined by two components:

- skill discretion;

- decision authority.

On the one hand, the first identifies conditions characterized by the possibility to learn new things, the degree of repetitiveness of tasks and the opportunity to enhance one's skills; on the other hand, the second basically identifies the level of control of the individual on the planning and organization of work.

Table 3. Lumbar pain in the last 7 days

Variable	NO	YES	P
Gender			
Female	28 (53.8)	24 (46.2)	0.102
Male	42 (68.9)	19 (31.1)	
Age	47 (27 – 68)	43.5 (26 - 64)	0.993
Years of work	10 (0.3 – 40)	12 (0.3 – 40.3	0.599
Continuous working hours			
No	8 (66.7)	4 (33.3)	0.722
Yes	62 (61.4)	39 (38.6)	
Job role			
Nurses	25 (51)	24 (49)	
Other health professions	5 (83.3)	1 (16.7)	
Technicians	4 (57.1)	3 (42.9)	0.204
Doctors in training	22 (66.7)	11 (33.3)	
Structured doctors	14 (77.8)	4 (22.2)	
BMI	23.4 (18.1 – 36.2)	24 (18.2 – 36.2)	0.316
Job strain	0.79 (0.59 – 1.01)	0.82 (0.49 – 1.28)	0.562
MET	2670 (495 - 17790)	3483 (0 - 79140)	0.224
MCS	48.3 (20.6 – 58.8)	48.8 (22.1 – 63.9)	0.668
PCS	55 (34.1 – 63.3)	50.6 (23.8 – 61.2)	**0.001**

Legend: BMI= Body Mass Index; MET = metabolic equivalent of task; MCS =Mental Component Summary; PCS =Physical Component Summary

Through this tool it was possible to identify the classic four working conditions, defined as:

high strain, high demand with low freedom of decision;

- passive, low demand with low decision making (work that does not encourage individual skills with marked levels of dissatisfaction);
- active, high demand with high decision (job with a high degree of learning and responsibility);
- low strain, low demand with high decision (optimal work situation, in which the individual can manage his working time independently).

In accordance with this model and by including the most significant variables, including the task performed, the highest LBP risk over the 12 months was found in groups with high labour demand and low decision-making opportunities, represented in this case by health care personnel in training.

The information on the physical activity performed was obtained by using the short form of the International Physical Activity Questionnaire (IPAQ), in which weekly frequency and average duration of physical activity (intense, moderate, walking) are required, regardless of whether during work or leisure time, and the number of hours per day spent sitting. In addition, to assess the degree of physical activity exercised and classify it as good / moderate / poor, the IPAQ uses METs (Metabolic Equivalent of Task), which have a different value depending on the effort

practiced, allowing to add up activities of different intensity.

By combining the main characteristics in a multivariate analysis and recoding the data for the task performed, the results show that ASS+OSS+OTA staff practice a good level of physical activity and are less at risk of developing LBP in the last 12 months.

Through the summary of the scores obtained from the 12 questions of the Short Form Health Survey (SF-12 standard V1 questionnaire), the general state of health was investigated using two synthetic indices, the Physical Component Summary (PCS) for the Physical State and the Mental Component Summary (MCS) for the Mental State.

The values of the synthetic indices vary, on the observed sample, from 23.8 to 63.3 for the PCS and from 20.59 to 60.15 for the MCS index, indicating that their growth indicates better psychophysical health conditions (Table 1).

Considering qualitative and quantitative variables and sample averages, the most relevant data acquired from all the questionnaires (gender, age, years of work, years of work in the company, days worked per week, continuous working hours, broken hours, daily standing hours, daily sitting hours, role, BMI, PCS, MCS, METs, Job demand and decision latitude) were associated with the incidence of lumbar pain in the last 12 months and the last 7 days (Tables 2 and 3).

There are significant variables associated with lumbar pain over the last 12 months:

- continuous working hours (p = 0.05);
- high PCS scores, in protective terms (the higher the PCS level, the lower the probability of having had lumbar pain in the last 12 months).

The only variable associated with lumbar pain in the last 7 days was PCS, with higher values of PCS indicating a protective effect.

The multivariate analysis shows different results for the two dependent variables (Table 4). Firstly, lumbar pain in the last 12 months is directly associated with years of work (OR = 1.16) and job demand (OR = 1.18), and inversely associated with age (OR = 0.81), decision latitude (OR = 0.87) and PCS (OR = 0.75). On the other hand, lumbar pain in the last 7 days is directly associated to being a nurse (OR = 2.55) and inversely associated PCS (OR = 0.91).

Table 4. Results of the multiple logistic regression analyses. Dependent variables: *Lumbar pain in the last 12 months - Lumbar pain in the last week*

Variable	Lumbar pain in the last 12 months		Lumbar pain in the last 7 days	
	Full model	Backward elimination model	Full model	Backward elimination model
Gender				
Female	1.66 (0.30 – 9.31)		0.73 (0.21 – 2.49)	
Male (ref.)	1		1	
Age	0.80 (0.69 – 0.92)	0.81 (0.71 – 0.92)	0.94 (0.85 – 1.04)	
Years of work	1.21 (1.04 – 1.41)	1.16 (1.03 – 1.32)	1.01 (0.92 – 1.10)	
Continuous working hours				
Yes	0.20 (0.04 – 1.03)	0.17 (0.04 – 0.81)	0.89 (0.23 – 3.41)	
No (ref.)	1	1	1	
Job role				
Nurses	0.60 (0.06 – 6.08)		3.37 (0.69 – 16.4)	2.55 (1.0 – 6.49)
Doctors	0.95 (0.09 – 9.8)		1.28 (0.22 – 7.21)	-
	1		1	1

Other health professions (ref.)				
BMI (Body Mass Index)	0.84 (0.69 – 1.03)		0.98 (0.84 – 1.13)	
Job demand	1.19 (1.01 – 1.40)	1.18 (1.01 – 1.38)	0.98 (0.87 – 1.10)	
Decision latitude	0.86 (0.733 – 1.01)	0.87 (0-76 – 1.0)	1.02 (0.92 – 1.12)	
MET	1.001 (0.99 – 1.003)		1.002 (1.00 – 1.003)	1.002 (1.00 – 1.003)
MCS	1.07 (0.99 – 1.16)		0.99 (0.94 – 1.05)	
PCS	0.74 (0.62 – 0.88)	0.75 (0.64 – 0.89)	0.91 (0.85 – 0.97)	0.91 (0.86 – 0.96)

Discussion

LBP is a very common health problem. In this study we found that in HCWs that work in operating theatre have a prevalence of LBP of almost 80% and 38%, in the last year and the last week, respectively.

Results show that 14 out of 113 candidates (12.4% of the total) had never experienced lumbar pain in their lifetime, while 99 (87.6%) had experienced LBP at least once in their life. These data do not differ from what is stated in scientific literature (26-27).

Based on the data we can assume that:

- LBP's incidence shows peaks in particular age groups characterized by intense work activity (28 to 32 years-old and 40 to 45 years-old).
- There is no significant difference in LBP's incidence between male and female population.
- High BMIs are statistically associated with LBP.
- A sedentary lifestyle and low physical activity levels are risk factors and aggravating factors for LBP.
- An adequate muscle mass tone significantly reduces LBP's occurrence.
- Excessive working hours, especially with insufficient recovery time between activities, increase the incidence of LBP.
- LBP's incidence is lower in nurses and higher in trainees, mainly because of the above-average number of continuous working hours for trainees.
- A high physical effort and an excessive mechanical load or an inadequacy of the load in relation to the physical competence of the subject increase the risk of experimenting LBP.

The etiopathogenesis of lumbar pain therefore involves countless variables, including biophysical factors, genetic factors, psychological factors, social factors and comorbidities (1,2).

Most surgeons are usually subjected to physical and mental stress and suffer from MSDs (physical fatigue, stiffness and pain) involving different body areas, arising during or after surgery (17). There is an association between risk factors and musculoskeletal disorders most frequently due to static positions and extreme postures that require sustained effort in the absence of breaks or with inadequate recovery timing between surgeries (28).

Each surgical specialty has its own ergonomic characteristics (position and height of the operating table, position of monitors, design of laparoscopic instrument handles, etc.) and this evidence suggests that particular groups of surgeons may be at higher risk of having symptoms related to their profession. In addition, the affected body area varies according to the surgical specialty (29-31).

Previous works show that many health care workers complain of generalized pain (17.2%) and physical fatigue (36.2%) and experience MSDs more than once in their working life. The areas of the body most affected

by skeletal muscle disorders, in descending order of incidence, are (32,33):

- lumbar region of the spine (66.9%);
- cervical area of the spine (with associated headache) (65.4%);
- dorsal area of the spine (22.4%);
- lower extremities (leg and foot) (12.1%);
- wrist and right hand (8.6%);
- shoulder and right arm (8.6%).

Many health professionals report that pain, particularly LBP, interferes with quality of life, mental and physical health, quality of sleep and social relationships (34).

Persistent low back pain comes along with several consequences and can cause temporary work disability with sick leave. Moreover, recurrent or persistent musculoskeletal disorders may affect the ability and efficiency of the surgeon to perform his or her work by encouraging him or her to favour the open surgical approach rather than minimally invasive surgery (MIS) and/or to reduce the number of procedures or to discontinue surgery early (15, 35).

From the prevention point of view, one of the most interesting results seems to be the protective effect on both dependent variables of the physical composite score, indicating that HCWs involved in operating room are a perfect target of preventive programs based on regular physical activity. This result is supported by a recent Systematic review and meta-analysis of RCTs focused on prevention of LBP that indicates physical exercise as a protective factor against the risk of episodic LBP and sick leave due to LBP in general population (36). Physical activity programs among professional health care workers could be recommended in order to prevent LBP, and this activity could be intended as part of a disability management program (15,17,37-39).

Another interesting point from a public health perspective is related to the association between job demand and decision latitude (as indicators of work-related stress) and LBP. Our results are in agreement with those coming from the scarce literature on this issue on HCWs (40,41), but according to our knowledge it is the first study that demonstrates the association between work-related stress items and LBP in operating room HCWs.

Some limitations in this study must be acknowledged. First of all, the study carried out has a cross-sectional design, and the casual relationship between risk or protective factors and LBP cannot be completely clear. Another possible limitation could be related to the settings involved, in terms of external validity. We involved only two settings (Orthopedics and Emergency Room) and the validity of the results can be considered for these. We cannot be sure to obtain the same results on other operating wards.

In conclusion, future research needs to go more deeply into the effects of physical activity experienced by health care workers in other operating room settings. The protective effect of physical activity and work-related stress management indicate room for improvements for these HCWs.

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