Symptoms and musculoskeletal diseases in hospital nurses and in a group of university employees: a cross-sectional study

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Background. Most studies have shown that nurses have a higher risk of developing musculoskeletal symptoms compared with other occupational groups. *Aim*. A cross-sectional study was performed to gain more insight into the prevalence rates of musculoskeletal disorders (MSDs) in nurses. *Methods*. The presence of musculoskeletal symptoms was revealed by personal interviews in a sample of 177 hospital nurses and in a reference group of 185 university employees. Musculoskeletal diseases were based on radiological examinations in all subjects. *Results*. Lower back pain (61% vs 42.2%) was the most frequently reported symptom, followed by neck pain (48.6% vs 38.4%) and shoulder pain (36.7% vs 25.9%), with a significantly higher prevalence in nurses. Women had about a 2-fold risk of upper limb region and neck pain compared with men. The most common abnormal findings on radiological examinations were disc herniations ($n = 40$). *Conclusions*. Nurses showed a significantly higher risk of MSDs. Prevalence rates in nurses increased significantly with age. Musculoskeletal symptoms were also common in university employees. This suggests the need for effective intervention strategies involving workers' active participation, in order to improve the process and organization of work and promote a positive psychosocial work environment.

Keywords: musculoskeletal disorders; nursing personnel; university employees; individual factors; multiple symptoms; radiological examinations

1. Background

All over the world, musculoskeletal disorders (MSDs) affect workers leading to different degrees of disability, also generating increasing absenteeism and temporary or permanent sick leaves, and producing costs in treatments and compensations. According to Eurostat, the Statistical Office of the European Communities,[1] MSDs are the most widespread and costly work-related health problem in Europe, affecting about 45 million workers. Indeed, in their 2010 report,[2] the European Agency for Safety and Health at Work called for more research into MSDs occurring in higher-risk groups such as women and younger and temporary workers, because these groups do not have any benefit from specific studies. Also, in Italy an increased occurrence of MSDs was observed over the past decade in the statistics of the National Insurance for Occupational Injuries and Diseases (INAIL).[3] According to these available data, since 2005 MSDs represent over 50% of compensable diseases in workers. Although MSDs are multifactorial in origin and may be associated with both occupational and non-work-related factors (e.g., individual characteristics, habits or psychological factors), epidemiological studies [4] show that the prevalence of MSDs varies by type of occupation. In health care, nurses as the largest professional group are at high risk of work-related MSDs. Lower back pain (LBP) is the most frequently reported symptom in nurses. Research [5–7] performed in several countries shows prevalence rates of 30–60%. Italian studies [8,9] report LBP prevalence rates (42–64%) in nursing personnel comparable with these and higher than those observed among the Italian general population (5.9%) and working populations who are not exposed to manual handling (2.3%). Other studies [5] also report neck and shoulder disorders respectively in 30–48% and 43–53% of nurses. Similar prevalence rates of neck (28–63%) and shoulder (4–49%) pain have been found in Italian nurses.[10,11] Several studies [6,12] report an association among MSDs, occupational injury, impairment, disability and work-related risk factors for musculoskeletal complaints in nursing. Among work-related risk factors, physical activities such as bending, twisting and other manual tasks [6] are considered casual factors in nurses' back injuries. Related to LBP, extreme flexion of the trunk and frequent heavy lifting [7] are also risk factors in nursing. In particular, biomechanical factors [13] that affect LBP include weight lifting, task asymmetry, lift rate, load position and reach distances. Engels et al. [6] found that lifting, awkward posture and stooping were associated with arm and neck disorders. Moreover, the psychosocial workload [4] including high demand, low level of social support and

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decision latitude are recognized as further possible risk factors.

Although several studies [4,14] show that nurses have a high incidence and prevalence of MSDs compared with other occupational groups, other studies [15,16] report high prevalence rates of musculoskeletal symptoms among non-exposed occupational groups such as office workers. Work-related neck disorders [17] are common in office workers, especially among those who are intensive computer users. In recent years, research on office workers [15,16] found high prevalence of neck pain (42.0–45.5%). Other studies on office workers in the past [17,18] have reported both higher and lower prevalence of neck pain. Office workers perform predominantly sedentary work. Ariens et al. [19] found a significant positive relation between sitting posture and neck disorders. Non-neutral wrist, arm and neck/shoulder postures, repetitive tasks, computer exposure as well as personal characteristics and psychosocial factors, such as time pressure and high perceived workload,[20] are believed to interact in the development of these symptoms. Several proposed theoretical models [21] of how psychosocial factors are associated with musculoskeletal symptoms in the neck/shoulder region suggest that adverse psychosocial variables cause mental stress, which may increase the risk of MSDs.

Recent studies [22,23] support a more global approach to MSDs analyzing the extent of musculoskeletal symptoms and the number of symptomatic anatomical sites rather than a particular site, either in the general population or in the working population.

However, research into the prevalence of MSDs [24] is hampered by a lack of uniformity in case definition by the absence of a gold standard for measurement [7,25] and by methodological problems [4] (concerning, e.g., different study designs and target groups/sample sizes, intercultural differences or inconsistent classification of the term MSDs). The term MSDs is used in the literature [25] to cover a range of clearly defined pathologies as well as non-specific pain characterized by an unclear clinical behavior and radiological appearance. The wide-ranging definitions of MSDs and the variety of criteria used to diagnose them generate uncertainty in the interpretation of results and in the comparison between the studies.[25,26] Although clinical diagnosis is normally made on the basis of more elements (self-reported symptoms, clinical evaluation, imaging test), most studies do not consider all of the aspects involved in the clinical decision, reporting prevalence based on the results of only one of the methodologies (usually self-reported symptoms). When investigating the prevalence of MSDs, the results of these measures should be evaluated together, if a reliable prevalence is obtained. Therefore, this study was performed to gain more insight into the prevalence rates of MSDs both in a sample of hospital nurses and in a working university group not exposed to specific musculoskeletal risk factors at work (e.g., manual patient handling) using different standard measurement tools (questionnaire and imaging tests). The specific aims of this study were: (a) to compare prevalence rates of musculoskeletal symptoms (in single or multiple body sites) in a group of 177 (exposed) nurses with those of a reference group of 185 university employees not exposed to lifting and carrying; (b) to examine significant associations between musculoskeletal symptoms and individual factors (e.g., gender, age); and (c) to evaluate, on the basis of radiological examinations, the prevalence of the most important musculoskeletal diseases both in the exposed group (177 nurses) and in the non-exposed group (185 university employees).

2. Methods

2.1. Study design

Between February 2011 and January 2012 a cross-sectional study based on health surveillance data was performed among a sample of nurses and a reference group of university employees. The nursing personnel sample involved 177 nurses (118 registered nurses and 59 auxiliary nurses) working in the Medical (44%), Surgical (38%) and Emergency (18%) Units in the University Hospital of Trieste. Nurses worked in units characterized as having moderate workloads and a moderate risk index (Movement and Assistance of Hospital Patients [MAPO] index [27] values in the range 1.51–5.00). The MAPO index was used to assess the risk of patient manual handling in hospital wards and to test the efficiency of preventive measures. The MAPO index was calculated on the basis of all these factors: disabled patient/operator ratios, lifting factor (e.g., number of patient lifting devices), minor aid factor (e.g., transfer disc, roller, ergonomic belt), wheelchair factor and environment and training factors. The reference group, not exposed to manual patient handling, consisted of 185 computer users employed in the university located in the same province of northern Italy. The main occupational categories were administration (52.4%) and university researchers (47.6%), with daily computer exposure for long-lasting periods (at least 20 h/week). The participants of the study were volunteers who had always worked in their profession, so that the confounding effect of different former occupations was thus excluded. The mean length of employment was 17 years for nurses and 11.4 years for university staff. All subjects were briefed on the research objectives and were required to sign an informed consent form.

2.2. Data

All Italian health care workers and computer users (at least 20 h/week) undergo a mandatory annual health examination by an occupational physician in charge of the medical surveillance. Data concerning musculoskeletal symptoms were gathered by means of questions administered by an occupational physician in the Occupational Medicine Unit,

University Hospital of Trieste. The interviews were conducted individually, during the annual health examination, to ensure that the subjects fully understood each question. The survey instrument is a questionnaire partly derived from the Standardized Nordic Questionnaire,[28] the only validated questionnaire since 1987, which has been modified by adding a lot of questions. It includes questions on: (a) history of musculoskeletal symptoms (including body drawing); (b) occupational features (profession, specific tasks, sector, length of employment, working hours, shift, computer use, professional history); (c) biological data (gender, age, height, weight); (d) social data (education and higher education, country/region of origin); and (e) lifestyle (sport activities, smoking). To assess musculoskeletal symptoms, for each anatomical site, participants were asked whether they had experienced ache, pain or discomfort during the previous 12 months. If the answer was positive, it was reported whether they had taken pharmaceutical drugs, undergone physiotherapy, been to see a specialist or undergone an imaging examination. Subjects were also asked a number of site-specific questions about their musculoskeletal symptoms such as the intensity and frequency of symptoms and the impact on work attendance and duties (e.g., activity limitation, difficulties in performing tasks at work and sick leave). The body sites referred to these questions were: neck, shoulder, upper back, lower back, upper limbs and lower limbs. For bilateral anatomical sites, musculoskeletal symptoms were classed as present if they were reported on either side or both sides of the body. These parameters have been used frequently, also in more recent studies,[5,22] enabling us to compare the results of the present study with reference data. According to the literature, 'musculoskeletal symptom' in our questionnaire was defined as having ache, pain or discomfort in order to involve chronic, acute or continuous symptoms. Once this questionnaire had been completed, each subject underwent a clinical examination and standard clinical tests to evaluate musculoskeletal symptoms. In all subjects, the presence or absence of any musculoskeletal disease was assessed on the basis of radiological reports, collected by an occupational physician during the health surveillance program. Thus, the related paper-based reports of magnetic resonance imaging (MRI), computed tomography (CT), ultrasound (US), electro-neurographic (ENG) and conventional radiology (X-ray) examinations, performed on nurses and university employees during their working life, were subsequently retrieved and analyzed.

Statistical analysis was performed using SPSS version 19. A probability level of $p < 0.05$ was accepted as statistically significant. Analysis of variance (ANOVA) and t test were used to evaluate differences between the exposed (177 nurses) and the non-exposed (185 university employees) groups. Categorical data were compared with the χ^2 test. To neutralize the influence of confounders, multivariate categorical logistic regression was used; length of employment was omitted from the model, because of its high correlation with age.

3. Results

The studied population involved 177 nurses and 185 university employees (Table 1). The majority of subjects were females. Nevertheless, there were differences in gender between the two occupational groups: the proportion of female nurses (77%) was significantly greater than female university employees (60%) ($p = 0.00$). Nurses working in shifts (rotating day/evening/night shifts) developed a schedule of 36 h/week, while among university staff working during the day the average of the working hours was at least 30 h/week. The average age and work experience among nurses were significantly higher than among the reference group ($p = 0.00$). The body mass index (BMI) and smoking also differed between the two occupational groups, with a greater proportion of subjects classified as obese (10.7%) and non-smokers (33.3%; $p = 0.00$) among nurses than among the reference group (4.3% and 15.7%, respectively). Concerning smoking, the proportion of current smokers among university staff (73.5%) was significantly greater than among nurses (58.8%, $p = 0.00$). Nurses and university employees had smoked an average of 13 cigarettes/day for 22 years and 11 cigarettes/day for 20 years, respectively. Of those with a history of smoking, 7.9% of nurses reported they had stopped smoking compared with 10.8% of university employees. Nurses and university staff had smoked an average of 14 cigarettes/day for 17 years and 16 cigarettes/day for 21 years, respectively. More than two-thirds (80%) of the nurses and half (59%) of the university employees reported at least one musculoskeletal symptom. Table 2 presents the prevalence rates of musculoskeletal symptoms in anatomical sites and regions during the previous 12 months. LBP was the most frequently reported symptom both in each professional group and in the whole population. However, between the two professional groups, the prevalence rate of LBP was significantly higher in nurses (61%; $p = 0.00$) compared with the reference group (42.2%). Neck and shoulder pain were also common in each occupational group, with a significantly higher prevalence in nurses ($p < 0.05$). The differences in prevalence between the two professional groups were also statistically significant for upper and lower limbs, with a higher prevalence in nursing personnel ($p = 0.00$). The prevalence of musculoskeletal symptoms affecting more than one anatomical site (on six studied sites) was more common among nurses ($p = 0.00$) than among university employees. Concerning the three anatomical regions studied (axial = upper back + lower back, upper limbs and lower limbs), neck and shoulders were considered part of the upper limb region. Nurses reported the presence of musculoskeletal symptoms in two anatomical regions (39.5%; $p = 0.00$) more frequently than the reference

Table 1. Sociodemographic characteristics in the two occupational groups.

Characteristic	Nurses ($n = 177$) n (%)	University staff ($n = 185$) n (%)	Total ($n = 362$) n (%)
Gender			
Male	41 (23.2)*	74 (40.0)	115 (31.8)
Female	136 (76.8)*	111 (60.0)	247 (68.2)
BMI			
≤16	1 (0.6)	0 (0.0)	1 (0.3)
17–25	121 (68.4)	141 (76.2)	262 (72.4)
25–30	36 (20.3)	36 (19.5)	72 (19.9)
≥30	19 (10.7)	8 (4.3)	27 (7.5)
Title			
Registered nurse	118 (66.7)	–	118 (32.6)
Auxiliary nurse	59 (33.3)	–	59 (16.3)
Administrative staff	–	97 (52.4)	97 (26.8)
Researcher	–	88 (47.6)	88 (24.3)
Smoking			
No	59 (33.3)*	29 (15.7)	88 (24.3)
Yes	104 (58.8)*	136 (73.5)	240 (66.3)
Ex	14 (7.9)*	20 (10.8)	34 (9.4)
	M (SD)	M (SD)	M (SD)
Age (years)	42.3 (10.2)*	38.7 (12.0)	40.5 (11.3)
Years of employment	17.0 (11.0)*	11.4 (11.7)	14.2 (11.7)

*$p < 0.01$ significant differences between nurses and university staff calculated by χ^2 test.
Note: BMI = body mass index; – = category not available for the corresponding group.

Table 2. Prevalence of musculoskeletal symptoms in single or multiple body sites.

Musculoskeletal symptom	Nurses ($n = 177$) n (%)	University staff ($n = 185$) n (%)	Total ($n = 362$) n (%)
Anatomical site			
Neck	86 (48.6)**	71 (38.4)	157 (43.4)
Upper back	33 (18.6)	33 (17.8)	66 (18.2)
Lower back	108 (61.0)*	78 (42.2)	186 (51.4)
Shoulders	65 (36.7)**	48 (25.9)	113 (31.2)
Upper limbs	36 (20.3)*	13 (7.0)	49 (13.5)
Lower limbs	48 (27.1)*	25 (13.5)	73 (20.2)
Anatomical region			
Axial	116 (65.5)*	81 (43.8)	197 (54.4)
Upper limb	113 (63.8)*	82 (44.3)	195 (53.9)
Lower limb	48 (27.1)*	25 (13.5)	73 (20.2)
One region	46 (26.0)*	42 (22.7)	88 (24.3)
Two regions	70 (39.5)*	61 (33.0)	131 (36.2)
Upper limb + axial	59 (33.3)*	50 (27.0)	109 (30.1)
Upper limb + lower limb	5 (2.8)	6 (3.2)	11 (3.0)
Axial + lower limb	6 (3.4)	5 (2.7)	11 (3.0)
Three regions	26 (14.7)*	6 (3.2)	32 (8.8)

*$p < 0.01$, **$p < 0.05$ significant differences in the prevalence between nurses and university staff calculated by χ^2 test.

group (33%). A significantly higher association between axial and upper limb regions was found in nurses (33.3%; $p = 0.00$) compared with university employees (27%). Compared with men, women reported musculoskeletal symptoms more frequently (Table 3). Among nursing personnel, the prevalence of musculoskeletal symptoms in the neck ($p = 0.00$) and upper limb ($p < 0.05$) regions was significantly higher in females than males. Among the university staff, 12-month prevalence rates were also higher in females than males for musculoskeletal symptoms of the neck, shoulders and upper limb region, but were significantly lower for the lower limbs ($p < 0.05$). There were also statistically significant differences in the prevalence of musculoskeletal symptoms across different age categories within the two vocational groups. Almost all prevalence rates (of a given symptom and in a given occupational group) increased with age. Nurses younger than 35 years reported significantly less LBP than those older

Table 3. Prevalence of musculoskeletal symptoms in the two occupational groups by gender and age.

Occupational group	Neck *n* (%)	Upper back *n* (%)	Lower back *n* (%)	Shoulders *n* (%)	Upper limbs *n* (%)	Lower limbs *n* (%)	Axial region *n* (%)	Upper limb region *n* (%)
Nurses ($n = 177$)								
Male ($n = 41$)	12 (29.3)	7 (17.1)	21 (51.2)	13 (31.7)	4 (9.8)	10 (24.4)	23 (56.1)	20 (48.8)
Female ($n = 136$)	74 (54.4)*	26 (19.1)	87 (64.0)	52 (38.2)	32 (23.5)	38 (27.9)	93 (68.4)	93 (68.4)**
Age (years)								
<34 ($n = 45$)	17 (37.8)	10 (22.2)	17 (37.8)	14 (31.1)	4 (8.9)	8 (17.4)	20 (44.4)	23 (51.1)
35–54 ($n = 110$)	60 (54.5)	19 (17.3)	77 (70.0)	41 (37.3)	27 (24.5)	31 (28.2)	79 (71.8)	75 (68.2)
>55 ($n = 22$)	9 (40.9)	4 (18.2)	14 (63.6)*	10 (45.5)	5 (22.7)	9 (40.9)	17 (77.3)*	15 (68.2)
University staff ($n = 185$)								
Male ($n = 74$)	24 (32.4)	15 (20.3)	33 (44.6)	15 (20.3)	6 (8.1)	15 (20.3)**	35 (47.3)	30 (40.5)
Female ($n = 111$)	47 (42.3)	18 (16.2)	45 (40.5)	33 (29.7)	7 (6.3)	10 (9.0)	46 (41.4)	52 (46.8)
Age (years)								
<34 ($n = 63$)	19 (30.2)	13 (20.6)	20 (31.7)	14 (22.2)	2 (3.2)	3 (4.8)	21 (33.3)	22 (34.9)
35–54 ($n = 96$)	39 (40.6)	15 (15.6)	39 (40.6)	29 (30.2)	9 (9.4)	16 (16.7)	41 (42.7)	45 (46.9)
>55 ($n = 26$)	13 (50.0)	5 (19.2)	19 (73.1)*	5 (19.2)	2 (7.7)	6 (23.1)**	19 (73.1)*	15 (57.7)

*$p < 0.01$, **$p < 0.05$ significant differences in the prevalence among nurses and university staff calculated by χ^2 test.

Table 4. Association between musculoskeletal symptoms and sociodemographic characteristics (multivariate analyses).

Characteristic	Neck *OR* [95% CI]	Lower back *OR* [95% CI]	Shoulders *OR* [95% CI]	Upper limbs *OR* [95% CI]	Lower limbs *OR* [95% CI]	Axial region *OR* [95% CI]	Upper limb region *OR* [95% CI]
Gender (female)	**2.43 [1.46, 4.04]**	1.38 [0.83, 2.27]	1.66 [0.97, 2.82]	1.88 [0.86, 4.11]	0.93 [0.51, 1.69]	1.33 [0.80, 2.20]	**2.05 [1.24, 3.37]**
Occupation	1.05 [0.66, 1.67]	**1.71 [1.07, 2.72]**	1.33 [0.82, 2.16]	**2.58 [1.26, 5.28]**	**1.93 [1.07, 3.51]**	**1.91 [1.19, 3.04]**	**1.59 [1.01, 2.53]**
Age	**1.03 [1.01, 1.05]**	**1.05 [1.03, 1.08]**	1.01 [0.99, 1.04]	**1.04 [1.01, 1.07]**	**1.03 [1.01, 1.06]**	**1.06 [1.04, 1.08]**	**1.04 [1.02, 1.06]**
BMI	0.98 [0.93, 1.03]	0.99 [0.95, 1.05]	0.99 [0.94, 1.04]	1.02 [0.96, 1.09]	**1.10 [1.03, 1.17]**	0.98 [0.93, 1.04]	1.00 [0.95, 1.06]
Smoking	**1.86 [1.10, 3.14]**	0.98 [0.58, 1.66]	1.62 [0.96, 2.74]	0.97 [0.47, 2.01]	1.28 [0.69, 2.38]	1.19 [0.70, 2.04]	1.66 [0.97, 2.83]

Note: $p < 0.01$ in bold. BMI = body mass index; CI = confidence interval; *OR* = odds ratio.

than 35 years ($p = 0.00$). Among university employees, subjects older than 35 years were more likely to have symptoms in all anatomical sites and regions (except for upper back) than those younger than 35 years, with statistically significant differences for lower limb ($p < 0.05$), axial region and lower back ($p = 0.00$) pain. Multivariate analysis (Table 4) revealed that women had about a 2-fold risk of upper limb region and neck pain compared with men. The odds ratio for age showed that subjects older than 35 years had more chance of having musculoskeletal

Table 5. Evaluation of all reports by anatomical site and positivity, in the two occupational groups.

	Neck (*n*)		Upper back (*n*)		Lower back (*n*)		Shoulders (*n*)		Upper limbs (*n*)		Lower limbs (*n*)	
Test	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
Nurses												
X-ray ($n = 198$)	44	12	2	2	36	10	15	6	28	6	26	11
US ($n = 27$)	0	0	0	0	0	0	7	9	1	2	3	5
CT ($n = 37$)	5	6	0	0	4	14	1	0	0	0	1	6
MRI ($n = 75$)	0	18	1	1	3	20	4	7	3	0	0	18
ENG ($n = 14$)	0	0	0	0	0	0	0	0	3	5	0	6
University staff												
X-ray ($n = 44$)	12	0	2	0	8	3	2	3	5	0	5	4
US ($n = 4$)	0	0	0	0	0	0	0	1	0	0	1	2
CT ($n = 8$)	1	1	0	0	0	5	0	0	0	0	1	0
MRI ($n = 18$)	2	1	0	1	2	7	0	1	1	0	2	1
ENG ($n = 2$)	0	0	0	0	0	0	0	0	0	2	0	0

Note: CT = computed tomography; ENG = electro-neurographic tests; MRI = magnetic resonance imaging; US = ultrasound; X-ray = radiographic.

Table 6. Differences between negative and positive subjects, divided by occupational group.

	Lumbar disc herniation		Cervical disc herniation		Rotator cuff syndrome	
Occupational group	Negative	Positive	Negative	Positive	Negative	Positive
Nurses ($n = 177$)	($n = 157$)	($n = 20$)	($n = 166$)	($n = 11$)	($n = 166$)	($n = 11$)
Symptomatic subjects[a]	56.7% ($n = 89$)	95.0% ($n = 19$)*	45.2% ($n = 75$)	100% ($n = 11$)*	32.5% ($n = 54$)	100% ($n = 11$)*
Characteristic,[b] M (SD)						
Age (years)	41.7 (10.3)	47.1 (7.6)**	41.8 (10.2)	49.3 (6.5)**	41.5 (9.9)	53.8 (7.0)*
Years of employment	16.3 (11.0)	22.1 (9.4)**	16.5 (10.9)	24.8 (9.4)**	16.2 (10.7)	29.0 (9.2)*
BMI	24.1 (4.7)	24.9 (5.8)	24.2 (4.8)	24.3 (4.4)	24.2 (4.8)	24.2 (4.5)
University staff ($n = 185$)	($n = 178$)	($n = 7$)	($n = 183$)	($n = 2$)	($n = 183$)	($n = 2$)
Symptomatic subjects[a]	39.9% ($n = 71$)	100% ($n = 7$)*	37.7% ($n = 69$)	100% ($n = 2$)	25.1% ($n = 46$)	100% ($n = 2$)
Characteristic,[b] M (SD)						
Age (years)	37.8 (12.1)	46.6 (12.6)	37.9 (12.2)	55.0 (2.8)	37.9 (12.2)	58.0 (4.2)
Years of employment	11.2 (11.6)	18.0 (10.9)	11.3 (11.5)	31.0 (8.5)	11.2 (11.4)	36.0 (5.6)
BMI	23.2 (3.8)	25.0 (1.2)	23.3 (3.7)	25.5 (3.5)	23.3 (3.7)	23.5 (4.9)

*$p < 0.01$, **$p < 0.05$ significant differences among nurses and university staff calculated by χ^2 test for discrete variables[a] and t test for continuous variables[b].
Note: BMI = body mass index.

symptoms in each body site (except for shoulder) than younger individuals. The role of occupation (nurses vs university employees) on the prevalence of musculoskeletal symptoms in almost all body sites (except for neck and shoulder) was confirmed. BMI increased only the risk of lower limbs pain. Smokers showed an increased risk for symptoms in the neck. A total of 427 reports of radiological examinations, collected by an occupational physician during the health surveillance program, were analyzed (Table 5). The reports of diagnostic imaging examinations were distributed as follows: 242 X-ray, 93 MRI, 45 CT, 31 US and 16 ENG. Among these examinations, the majority ($n = 351$) were performed in 106 nurses and the remaining ($n = 76$) in 48 university employees. Most of the conventional radiology studies excluded the presence of pathology, whereas a large proportion of MRI and CT examinations recorded morphological and degenerative alterations. In nurses most of radiographic tests were performed after occupational injuries. Indeed, traumatic events were more frequent among nurses ($n = 209$) compared with university employees ($n = 6$). The majority of radiological examinations were performed on the cervical and lumbar spine. The most common abnormal findings in the cervical and lumbar spine were disc herniations ($n = 40$), spondylolisthesis ($n = 12$), disc protrusions ($n = 9$) and facet joint osteoarthritis ($n = 5$). Cervical and lumbar disc herniations were present in 28 nurses (23 females and 5 males, 3 female nurses had cervical as well as lumbar disc herniation) and in 9 university employees (5 males and 4 females). In each occupational group, the individuals with cervical and lumbar disc herniations had a higher average age and work experience ($p < 0.05$ for nurses) compared with those without disc herniations; BMI and smoking did not show significant differences between the two subgroups under study (Table 6). Diagnostic imaging examinations of the shoulder showed some morphological and degenerative alterations of the anatomical structures, including tendon calcifications ($n = 4$) and biceps tendon lesions ($n = 2$). According to radiological examinations, 11 nurses (10 females and 1 male) and 2 university employees (1 female and 1 male) were found to have rotator cuff syndrome, of which 9 were on the dominant side, 1 on the non-dominant side and 3 bilateral. Within the two occupational groups, subjects with rotator cuff syndrome had a higher average age and work experience ($p < 0.01$ for nurses) compared with those without this pathology (Table 6). The most common radiological findings of upper limbs and lower limbs registered inflammatory or traumatic diseases. Carpal tunnel syndrome, of which 3 were on the dominant hand and 2 were bilateral, were found in 5 females (4 nurses and 1 university employee). The prevalence of disc herniations and rotator cuff syndrome in symptomatic subjects is summarized in Table 6. Among nurses, lower back, neck and shoulder pain were significantly associated with the presence of disc herniations and rotator cuff syndrome ($p = 0.00$). Only one of the nurse subjects without LBP ($n = 69$) had a lumbar disc herniation. A similar association between LBP and lumbar disc herniation ($p = 0.00$) was found among the university staff.

4. Discussion

The presented data are consistent with the hypothesis that the prevalence of MSDs may be substantially higher in nurses than in a reference group not exposed to specific musculoskeletal risk factors at work (such as manual patient handling). This is in accordance with other epidemiological studies [6,13] and plausible on the basis of the biomechanical and ergonomic knowledge of nurses' work conditions. The study results also revealed a high prevalence rate for musculoskeletal symptoms among

university employees, suggesting a common occupational complaint in the study population. Approximately more than two-thirds (80%) of the nurses and half (59%) of the university employees reported musculoskeletal symptoms at any body site in the previous 12 months. The results showed that lower back as well as neck/shoulder symptoms were major health problems in the two professional groups under study. The lower back was the most common site affected. Among nurses the prevalence rate of LBP was 61%, which was significantly higher than the prevalence reported by university employees (42.2%). Several studies in the past,[5,7,8] using the same type of questions and focusing on health care workers, found prevalence rates of 30–60%. These findings are comparable with our results and support the hypothesis [29] that nurses more frequently report lower back disorders compared with other occupational groups, since the lifting and carrying of patients – often performed in an unfavorable posture – is a regular part of nurses' daily work. On the other hand, care activities and dragging or pushing beds/stretchers/wheelchairs (with patients) are more related to pain in the shoulder and neck.[6] In the present study among nurses the prevalence rates of neck and shoulder symptoms were almost 49% and 37%, respectively, which were higher than those reported by university employees. Other studies [5,10] found rather similar rates. Studies performed on nursing home workers [30] found that a sustained or repeated working posture with the arm abducted increased the possibility of neck and shoulder pain. The shoulder and neck are biomechanically linked, and any sustained or repeated arm abduction induces activation of scapular muscles and, in particular, increases trapezius activity. Although the evidence for an association between muscle activity and pain is conflicting, neck pain radiation mostly occurs to the shoulder and vice versa [31]. Among the university employees who performed predominantly sedentary work (the majority of these subjects were administrative workers), neck and shoulder symptoms were frequent. Neck pain (38.4%) was almost as prevalent as back pain (42.2%) and about one-quarter of the subjects (25.9%) reported shoulder pain. An earlier study on office workers [15] found lower prevalence rates of lower back (34%) and shoulder (16%) pain and a higher prevalence rate of neck pain (42%). Cagnie et al. [16] demonstrated that holding the neck in a forward bent posture and working in the same position for a prolonged time were significantly associated with neck pain. A previous study [19] showed a positive relation (although not significant) between neck flexion and neck pain. A significant positive relation was also found between neck pain and sitting posture [19] and computer working time [16]. Although nurses reported less symptoms in the upper (20.3%) and lower (27.1%) limbs, there was a statistically significant difference between the two groups ($p = 0.00$). In the present study, prevalence rates of musculoskeletal symptoms in more body sites were higher in nurses than in university employees. For example, neck pain was associated with symptoms in shoulder and upper limbs more frequently in nurses than in university employees (63.8% vs 44.3%; $p = 0.00$). Nurses (39.5%) reported the presence of musculoskeletal symptoms in two anatomical regions more frequently than the reference group (33%; $p = 0.00$). A significantly higher association between axial and upper limb regions was found in nurses (33.3%) compared with the university employees (27%). Smedley et al. [32] found that prior lower back symptoms were the strongest predictor for pain in the neck and shoulder. Although a full understanding of the underlying biological mechanism leading to and perpetuating musculoskeletal symptoms has yet to be defined, it is implicit that the body functions as a whole and when subject to risk will probably respond as a whole. The pain or injury may occur in one body region, but the body is expected to use other regions to reduce the pain or compensate that weakness. If a nurse is suffering from pain or injury to the lower back and is required to engage in patient handling, he/she may attempt to direct the patient's weight onto the arms using the knees and legs (not the lower back) for stabilization, causing stress on those areas. In addition, the impact of LBP on a nurse's quality of personal and work life may increase the risk of psychological stress, possibly leading to symptoms in other body areas.[22]

In this study, the sample of nurses, primarily females (76.8%), had mean age and work experience significantly higher than those of the reference group. These individual characteristics may have also influenced the higher prevalence of symptoms reported by nurses in various anatomical sites.

According to previous research, [23] when the prevalence of musculoskeletal symptoms was compared by gender it was found within the two vocational groups that prevalence of musculoskeletal symptoms was higher in women than in men. In particular, among nurses and university employees, symptoms in the neck, shoulder and upper limb regions were more common among women than men. Multivariate analysis largely confirmed the results of univariate analysis. In general, women seem to be at risk with a higher prevalence of upper limb, shoulder and neck pain than men.[33] Possible explanations [34] for the gender difference in prevalence include different exposures and working conditions (even within the same type of job), an interaction between gender and personal factors as well as biological and psychological differences. In a review of epidemiological findings on computer work and musculoskeletal symptoms, Tittiranonda et al. [20] suggested that differences in anthropometrics may put women at a disadvantage as they work in more extreme postures or use relatively greater muscle force than men. Other hypotheses [35,36] to explain this disparity are that women have a lower pain threshold and that they might be more prone to express pain and symptoms. Additionally, it is hypothesized that many women are suffering from non-specific pain, for which psychological or psychosocial

factors have recently been invoked. The prevalence of non-specific pain [37] in female adult populations has been estimated to be between 2.5% and 13.7%. In line with earlier studies,[16,23] a significant relationship was found in the current study between age and prevalence of musculoskeletal symptoms in various body sites, except for the shoulder. Nurses and university employees younger than 35 years reported less lower back ($p = 0.00$) and neck pain than those older than 35 years. Our findings are in accordance with the degenerative changes seen on radiological examinations [38] of the cervical spine in most subjects older than 30 years and the increasing susceptibility of tissues and joints to physical loads. The finding in this study that about one-third of the nurses (31%) were overweight (20.3%) or obese (10.7%) and one-quarter (23.8%) of the university employees were overweight (19.5%) or obese (4.3%) was a motive for concern, since obesity places pressure on disc endplates and facet joints and can also place excessive force on other joints in the body.[39] In our study, BMI was associated with an increased risk of lower limb pain. Another finding was that more than half of the subjects (58.8% of nurses and 73.5% of university employees) were current smokers. Smoking can affect the musculoskeletal system through: (a) blood flow reduction, hypoxia or chemical changes leading to muscle, joint and disc degeneration; and/or (b) excitatory effects of nicotine that may alter the perception and threshold of pain, increasing self-reporting among smokers.[40] Concerning the relationship between lifestyle factors (obesity/smoking) and musculoskeletal symptoms, the results are controversial. Several studies [39,40] found increased risk of symptoms with increased BMI and smoking. Other studies [41] showed a low prevalence of MSDs among overweight individuals and smokers. In this study, smoking was found to be associated with neck pain.

Because these results are based on subjective questionnaire data, some methodological shortcomings within this study should be mentioned. First, the cross-sectional design of this study does not permit causal inference from the observed associations. Moreover, given the limited study population, subjects may not represent the entire range of nursing personnel or university staff, and they may have been more receptive to participating because they suffered from musculoskeletal symptoms. However, since the analysis was limited to currently working subjects, we may have excluded workers who had left the job because of MSDs. The effects of these potential selection biases could not be evaluated, but the mean duration of employment in the current work of more than 10 years suggests that the study was conducted in a stable population. Hence, it is expected that selection bias will not have influenced the observed associations to a great extent. The results may also be affected by recall bias, since the questionnaires have been filled out retrospectively. However, the recall bias can be minimized insofar as one may assume that the bias in question affects nurses and university employees to a similar degree. In the end, we have collected no information on personality traits (e.g., psychological distress, mental stress) despite their possible association with musculoskeletal symptoms.

However, on the basis of the results of this study and those derived from the available literature, it is difficult to say how a higher prevalence of self-reported musculoskeletal symptoms in nurses corresponds with a higher morbidity or reflects different perceptions of pain. Therefore, it was considered useful to validate our results through data that possess a higher degree of 'objectivity' compared with subjects' self-reports on musculoskeletal symptoms. These data consisted of diagnoses that were made with the aid of radiological examinations (X-ray, US, CT, MRI and ENG methods) performed on nurses and university employees during their working life. When radiology reports were collected and analyzed for each professional group, it was found that nurses had a greater number of examinations ($n = 351$) compared with those performed on university employees ($n = 76$). In nurses most of the tests concerned conventional radiology studies (198/351) which, in a large proportion, ruled out the presence of pathological findings. It should be noted that the majority of these radiographic examinations were performed immediately after occupational injuries linked to the manual handling of loads and to different traumatisms in various body sites. Indeed, hospital nurses were found to be at greater risk of sustaining a professional injury (209 traumatic events as a whole) compared with university employees (6 traumatic events as a whole). Most reports of CT and MRI examinations in the study groups confirmed the presence of pathology. The neck and lower back were the anatomical sites most frequently examined in both occupational groups. According to a previous study that evaluated the abnormal findings on MRI of the lumbar spine in female nurses and secretaries,[42] no differences were found between the two professional groups in the current study. The most common findings in radiological examinations of the cervical and lumbar spine were, in order, disc herniation and protrusion, spondylolisthesis and facet joint osteoarthritis. However, among nursing personnel the prevalence of disc herniations (28/177, 16%) in at least one intervertebral disc (3 nurses had both cervical and lumbar disc herniations) was higher compared with that of university staff (9/185, 5%). When, within the two vocational groups, nurses and university employees with and without disc herniation were compared, the average age and work experience were higher in subjects (older than 45 years) with disc herniation than in subjects (younger than 45 years) without disc herniation. This is in accordance with a recent longitudinal MRI study,[38] which reported a higher progression of disc degeneration in elderly subjects with development of clinical symptoms. Age and work experience were also associated with the presence of rotator cuff syndrome both in nurses (11 subjects) and in university employees (2 subjects).

Other detected radiological findings in the shoulder, upper limbs and lower limbs (calcific tendinopathy, traumatic lesions/meniscus rupture, carpal tunnel syndrome) were less common than disc diseases. Comparing these results with other studies was not an easy task, since no detailed information is available on the occurrence of rotator cuff syndrome and disc herniations in working populations. Silverstein et al. [43] reported a claim incidence rate of 19.9 per 10,000 full-time equivalents per year for rotator cuff syndrome. In a study performed among Danish drivers,[44] the rate of hospitalization for cervical disc herniation was 0.33 per 1000 driver-years, whereas in the general population the incidence was 0.055 per 1000 person-years. Another study [45] found that the prevalence of herniated lumbar discs (6.8%) was higher in subjects employed in geriatric hospitals as compared with that (3%) of the external reference group. A relation between working as a nurse and the diagnosis of lumbar disc herniation was also found by Jörgensen et al.[46]

Our data show that the reported presence of symptoms was not so reliable in predicting whether musculoskeletal pathology was present. Depending on the outcome measure used, the prevalence of MSDs varied remarkably. There was a striking difference between the prevalence of subjective reported symptoms and the results of imaging tests. According to examinations, 20 nurses (11%) and 7 university employees (4%) had a lumbar disc herniation, although approximately more than half (61%) of the nursing personnel and one-third (42.2%) of the university staff reported LBP. However, these results are consistent with the hypothesis that the prevalence of disc herniations in people with back pain may be significantly higher than in people without symptoms. Given the high prevalence of LBP (51.4%) in the studied population, only one (1 nurse) of the asymptomatic subjects (48.6%) had a lumbar disc herniation. In the musculoskeletal field there are well-documented examples [47] where symptoms and imaging are often not correlated (e.g., disc protrusion or herniation in LBP-free subjects). A possible reason for this discordance might be the use of methodologies [48] that identify the presence of a structural defect without considering other parameters such as alterations in kinematics and associated muscle activity. In some cases, this apparent discordance could also be due to the role of non-specific pain,[37] which can be defined as the presence of pain without physical signs or any recognizable underlying pathology. According to the results, ageing had a statistically significant effect on the prevalence of MSDs, whether reported or diagnosed objectively.

In conclusion, the present study confirmed the multifactorial origin of MSDs and showed that physical and psychosocial work factors (job type, characteristics physical loadings) as well as individual factors (female gender, advanced age) were associated with the prevalence of MSDs. In this study the exposed group was composed of nurses performing shift work in order to provide 24-h health care, whereas the reference group worked during the day. Research on nurses [49,50] has shown that shift work is correlated with increases in musculoskeletal symptoms and work-related injuries, including MSDs and stress. Compared with the reference group, nurses who worked in Medical, Surgical and Emergency Units were exposed to a higher physical load by performing job tasks such as manual handling and twisting, forceful movements or awkward postures. Furthermore, the presence of critically ill patients may increase the level of emotional and physical tension caused by the high demand and complexity of care**.** According to the results, although musculoskeletal symptoms were significantly more frequent in nurses, they were also frequent in university employees. This suggests, for the last professional group, the need for effective intervention strategies that take into account both ergonomic improvements and cognitive behavioral aspects (e.g., computer exposure). The study results showed also a higher musculoskeletal morbidity (prevalence of pathologies) in the sample of nurses. These data can reasonably be associated with certain risk occupations, such as hospital nursing. The university hospital studied showed the same reality of most university hospitals, such as: overcrowded with patients, presence of severely ill patients in all units, shortage of professionals and lack of support equipment for handling patients. This condition could play a role in the occurrence of MSDs, by increasing muscular tension or by causing a more generalized stress reaction.[22] A strategy to minimize this problem would be the surveying of health conditions by periodic assessments on nursing personnel rather than annual evaluations and implementation of preventive measures (e.g., availability of lifting devices supported with training designed to ensure their use). It is also important to encourage nurses' active and collective participation to search for the best solutions in order to improve the process and the organization of work and stimulate a positive psychosocial work environment.

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Disclosure statement

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