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CLASSIFICATION OF NECK/SHOULDER PAIN IN EPIDEMIOLOGICAL RESEARCH: A COMPARISON OF PERSONAL AND OCCUPATIONAL CHARACTERISTICS, DISABILITY AND PROGNOSIS AMONG 12,195 WORKERS FROM 18 COUNTRIES

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Abstract

To inform case-definition for neck/shoulder pain in epidemiological research, we compared levels of disability, patterns of association and prognosis for pain that was limited to the neck or shoulders (LNSP) and more generalised musculoskeletal pain that involved the neck or shoulder(s) (GPNS). Baseline data on musculoskeletal pain, disability and potential correlates were collected by questionnaire from 12,195 workers in 47 occupational groups (mostly office workers, nurses, and manual workers) in 18 countries (response rate = 70%). Continuing pain after a mean interval of 14 months was ascertained through a follow-up questionnaire in 9,150 workers from 45 occupational groups. Associations with personal and occupational factors were assessed by Poisson regression and summarised by prevalence rate ratios (PRRs). The one-month prevalence of GPNS at baseline was much greater than that of LNSP (35.1% vs. 5.6%), and it tended to be more troublesome and disabling. Unlike LNSP, the prevalence of GPNS increased with age. Moreover, it showed significantly stronger associations with somatising tendency (PRR 1.6 vs. 1.3) and poor mental health (PRR 1.3 vs. 1.1); greater variation between the occupational groups studied (prevalence ranging from 0% to 67.6%) that correlated poorly with the variation in LNSP; and was more persistent at follow-up (72.1% vs. 61.7%). Our findings highlight important epidemiological distinctions between sub-categories of neck/shoulder pain. In future epidemiological research that bases case definitions on symptoms, it would be useful to distinguish pain which is localised to the neck or shoulder from more generalised pain that happens to involve the neck/shoulder region.

Keywords

Neck pain; shoulder pain; diagnostic classification; case definition; disability; associations; prognosis

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Introduction

Pain in the neck and/or shoulder(s) is a common problem in people of working age, and an important cause of disability. Like other regional pain, it may arise from identifiable musculoskeletal pathology – for example, cervical spondylitis or sub-acromial bursitis. However, the relationship of such abnormalities to symptoms is imperfect [17], and their occurrence in association with pain does not necessarily imply that they are responsible for it. Furthermore, some modes of investigation that might be used to detect relevant pathology, in particular magnetic resonance imaging (MRI), are relatively expensive and not readily applicable in large surveys. Most epidemiological studies of neck and shoulder pain have therefore defined cases by the occurrence and characteristics of symptoms. Moreover, because neck/shoulder pain can be difficult for patients to localise precisely and commonly extends across both the neck and shoulders, it has often been treated as a single diagnostic entity. Using this approach, it has been linked with occupational physical activities such as manual materials handling [20], awkward postures [2,20,24], and use of computers [28]; psychological factors such as low mood [8] and tendency to somatise [15]; and various psychosocial aspects of work [16,21,24].

The merits of aggregating all pain in the neck and shoulder region will depend on whether there are identifiable subsets of cases that differ importantly in their causes, prognosis or response to treatment [4]. For example, pain in the neck/shoulder is often accompanied by pain at other anatomical sites [1,13,14,25]. Pain that is localised only to the neck or shoulder might be more reflective of local pathology, while some psychological factors might show stronger associations with pain which, although involving the neck or shoulder, is more widespread. If such distinctions occur then associations with causes and effects of treatment may be diluted when all cases are aggregated.

The CUPID (Cultural and Psychological Influences on Disability) study is a large international investigation in which information about musculoskeletal pain, associated disability, and potential risk factors was collected from workers employed in 47 occupational groups distributed across 18 countries [5]. To explore whether there are differences between sub-categories of neck/shoulder pain in associations and/or prognosis, we analysed data from the CUPID study, focusing in particular on pain that was limited to the neck or shoulder as compared with more generalised musculoskeletal pain that involved the neck or shoulder but also affected other anatomical sites. As well as comparing associations with demographic, physical, psychological and psychosocial factors, we examined differences between the sub-categories of pain in their relative prevalence by occupational group.

Methods

During 2006–11, baseline information was collected by questionnaire from 47 occupational groups in 18 countries. Participants were aged 20–59 years, and had been employed in their current job for at least 12 months. The occupational groups fell into three broad categories – nurses, office workers and other workers (mostly carrying out manual tasks with their arms). In most groups, potentially eligible subjects were identified from employers' records, in some cases with random sampling to achieve the desired sample size (at least 200 per group

if possible). The number of participants by group (mean response rate = 70%, response rate >80% in 33 of the 47 groups) varied from 92 to 1018, giving a total sample size of 12,426.

The questionnaire, which was completed either by self-administration or at interview, was originally drafted in English and then translated into local languages where necessary, with independent back-translation to ensure accuracy. Among other things, it covered demographic characteristics (sex and age), occupational activities (in an average working day), psychosocial aspects of work, somatising tendency, mental health, beliefs about arm pain, and experience of musculoskeletal pain and associated disability.

Somatising tendency was assessed through questions taken from the Brief Symptom Inventory [9], and was classified according to the number of symptoms from a total of five (faintness or dizziness, pains in the heart or chest, nausea or upset stomach, trouble getting breath and hot or cold spells) that had been at least moderately distressing during the past week. Mental health was ascertained using elements from the Short Form-36 (SF-36) questionnaire [29], and was graded to three levels (good, intermediate and poor) representing approximate thirds of the distribution of scores in the full study sample. Questions on beliefs about arm pain were adapted from the Fear Avoidance Beliefs Questionnaire [27]. Participants were classed as having adverse beliefs about the work-relatedness of arm pain if they completely agreed that such pain is commonly caused by work; about the impact of physical activity if they completely agreed that for someone with such pain, physical activity should be avoided as it might cause harm, and that rest is needed to get better; and about its prognosis if they completely agreed that neglecting such problems can cause serious harm, and completely disagreed that such problems usually get better within three months.

The questions about musculoskeletal pain concerned 10 anatomical sites (low back; neck; and left and right shoulder, elbow, wrist/hand and knee), which were illustrated with body mannequins. For each site, participants were asked whether they had experienced pain that had lasted for longer than a day (a) during the past 12 months and (b) during the past month. Pain in the neck or shoulder was classed as disabling if it had made it difficult or impossible to get dressed, do normal jobs around the house, or (for shoulder only) comb/brush hair or bath/shower.

Approximately 14 months after baseline, participants from 45 occupational groups who had given consent, were asked to complete a shorter follow-up questionnaire, which used identical questions to ascertain experience of musculoskeletal pain in the past month. Follow-up was not possible for office workers in South Africa or for manual workers in Costa Rica. Further details of the methods of data collection in the CUPID study have been reported elsewhere [5].

Statistical analysis was carried out with Stata version 12.1 software (Stata Corp LP, College Station TX, USA), and focused on the one-month prevalence at baseline of two main categories of pain: localised neck/shoulder pain (LNSP) and generalised pain involving the neck or shoulder(s) (GPNS). The former was defined as pain in the neck and/or shoulder(s) with no pain at any of the other seven anatomical sites during the past 12 months. Neck or

shoulder pain during the past month that occurred in a context of pain at one or more other anatomical sites during the past 12 months was classed as GPNS. Within the category of LNSP, we further distinguished two subsets of cases – those in whom all pain in the past 12 months was restricted to the neck (localised neck pain), and those in whom all pain in the past 12 months was limited to one or both shoulders (localised shoulder pain).

We first used simple descriptive statistics to describe the frequency and severity of different pain outcomes at baseline. Next, we applied Poisson regression with confidence intervals (CIs) based on robust standard errors to assess the cross-sectional association of various personal and occupational factors with each of LNSP, GPNS, localised neck pain and localised shoulder pain. In each analysis, the measure of pain was taken as the outcome variable, and the comparison group was people with no pain in either the neck or shoulders in the past 12 months. To account for possible clustering by occupational group, we used hierarchical, random intercept modelling, associations being summarised by prevalence rate ratios (PRRs). To assess the significance of differences in associations for LNSP and GPNS, we carried out a further Poisson regression analysis with GPNS as the outcome and LNSP as the comparator. Similarly, the significance of differences in associations with localised neck as compared with localised shoulder pain was assessed through a model with localised neck pain as the outcome and localised shoulder pain as the comparator.

We then examined the prevalence of LNSP and GPNS by occupational group, and their correlation after adjustment for other factors. To derive adjusted prevalence rates, we first took no neck/shoulder pain in the past 12 months as a comparator, and estimated PRRs for LNSP and GPNS in each occupational group relative to a reference (office workers in the UK), using Poisson regression models that included the other factors. Next, we calculated the “adjusted numbers” of participants in each occupational group with the two pain outcomes that would give crude PRRs equal to those estimated from the regression model. We then used these adjusted numbers to calculate adjusted prevalence rates.

Finally, we explored the prevalence of continuing pain in the month preceding follow-up for different categories neck/shoulder pain at baseline.

Ethical approval for the study was provided by the relevant research ethics committee in each participating country [5].

Results

One hundred and ninety of the 12,426 participants were excluded from the analysis because of missing information about pain in the neck or shoulders in the past month and/or 12 months, together with a further 41 who provided incomplete data on pain at other anatomical sites in the past 12 months. Among the remaining 12,195 subjects, 4,241 (35%) were men.

Table 1 shows the one-month prevalence and severity of different categories of neck/shoulder pain at baseline. Overall, neck/shoulder pain in the past month was common (40.7%), and occurred mostly in a context of more widespread pain in the past 12 months (prevalence = 35.1%). In contrast, the prevalence of pain that was localised to the neck and/or shoulders was lower (5.6%), and particularly that of pain which was limited entirely

to the shoulders (1.2%). Most of the latter was restricted to a single shoulder (122 of the 152 cases). Most participants with GPNS (93%) reported pain in the past 12 months in the low back and/or knees as well as any pain in the upper limb. GPNS tended to be more troublesome and disabling than LNSP. For example, it had made everyday activities difficult or impossible during the past month in 56.9% of cases as compared with 35.6% of those with LNSP; and it had caused absence from work during the past year in 20.3% of cases as compared with 11.3% of those in whom the pain was localised. When the analysis was repeated separately for eight strata of sex and age, the patterns were similar across each stratum.

Table 2 shows baseline associations with personal and occupational factors separately for LNSP and GPNS, in comparison with no pain in the neck or shoulders in the past 12 months. Both categories of pain were significantly more frequent in women than men (PRRs of 1.4 and 1.3 respectively), and both were associated with tendency to somatise. However, the relationship to somatising tendency was stronger for GPNS (PRR 1.6, 95%CI 1.5–1.8, for report of distress from two or more somatic symptoms compared to none, p for trend <0.001) than for LNSP (PRR 1.3, 95%CI 1.1–1.5 for report of distress from two or more somatic symptoms compared to none, p for trend <0.001). GPNS also showed a stronger association with poor mental health, and unlike LNSP, its prevalence increased significantly with age. Direct comparison of the two pain outcomes (in a single Poisson regression model that effectively took those with GPNS as cases and those with LNSP as controls) indicated that the differences in associations with age, somatising tendency and mental health were statistically significant ($p < 0.05$). In addition, both categories of neck/shoulder pain were more weakly linked with prolonged use of keyboards at work (PRR 1.3 for LNSP and 1.1 for GPNS) and adverse beliefs about the prognosis of arm pain (PRRs 1.3 and 1.1 respectively); and GPNS with occupational lifting, work with the hands above shoulder height and adverse beliefs about the work-relatedness of arm pain.

Table 3 presents corresponding risk estimates for localised neck pain and localised shoulder pain, defined as in Table 1 (again the comparator was no pain in the neck or shoulders in the past 12 months). There were clear differences in the patterns of association, such that the prevalence of localised neck pain was markedly higher in women than men (PRR 1.7, 95%CI 1.2–2.3), lower at older ages (p for linear trend across age categories = 0.04), and significantly associated with somatising tendency, lack of support at work, job insecurity, and particularly with use of a keyboard for >4 hours in an average working day (PRR 1.9, 95%CI 1.5–2.4). In contrast, localised shoulder pain was associated with work with the hands above shoulder height (PRR 1.3, 95%CI 1.0–1.8) and belief that arm pain has a poor prognosis (PRR 1.4, 95% CI 1.0–2.1). Direct comparison of localised neck pain with localised shoulder pain indicated that the differences in associations with age, use of a keyboard and lack of support at work were statistically significant ($p < 0.05$).

Figure 1 summarises the crude prevalence of LNSP and GPNS across the 47 occupational groups. In almost all groups, GPNS predominated. Rates for LNSP ranged from 0.5% among flower plantation workers in Ecuador and 1.1% in Colombian office workers to 11.2% and 11.8% in office workers from Spain and Sri Lanka respectively. For GPNS the variation between occupational groups was even greater with zero prevalence among sugar

cane cutters in Brazil and a rate as high as 67.6% in Costa Rican telephone call centre workers. Office workers tended to have higher prevalence of LNSP than nurses, but there were no consistent differences in GPNS by type of occupation. The proportion of neck/shoulder pain that was localised did not relate consistently to its overall prevalence.

Figure 2 plots the prevalence of LNSP by occupational group against that for GPNS, after adjustment for the factors listed in Table 2. Following such adjustment, the variation in GPNS was a little reduced, and there was little correlation between the two types of pain (Spearman correlation coefficient = 0.22 overall, 0.46 in nurses, -0.47 in office workers and 0.45 in other workers).

Follow-up data were sought for 45 of the 47 occupational groups, and among the 11,764 participants in these groups, 9,150 (78%) provided satisfactory information about neck and shoulder pain after a mean interval of 14 months (range 3–35 months, 84% within 11–19 months) from baseline. Table 4 shows the prevalence of continuing pain at follow-up for different categories of neck/shoulder pain at baseline. The persistence of neck/shoulder pain was significantly higher ($p = 0.003$) when it was associated with pain at other anatomical sites in the past year (72.1%) than when it was localised (61.7%). Persistence was lowest for pain that was localised to the shoulders, with a prevalence of 31.9% for pain in the shoulder(s) during the month before follow-up, and 41.6% for pain in the neck or shoulders.

Discussion

Our findings indicate that most neck and shoulder pain occurs in a context of current or recent pain at other anatomical sites, and that in these circumstances, it tends to be more troublesome and disabling than pain which is localised entirely to the neck/shoulder area. Furthermore, it appears that these two sub-categories of neck/shoulder pain differ importantly in their epidemiology. Thus, GPNS showed stronger associations with somatising tendency, poor mental health and older age, greater variation between the occupational groups studied (which correlated poorly with the variation in LNSP), and tended to be more persistent. There were also differences between pain that was localised to the neck and that which was localised to one or both shoulders, the former being less frequent at older ages, and strongly associated with prolonged use of keyboards at work.

Several earlier reports have described the occurrence and determinants of neck/shoulder pain in specific occupational groups from the CUPID study in Australia [15], Brazil and Italy [3], Estonia [10,22], Iran [26], Japan [19], New Zealand [11,12] and Sri Lanka [30]. However, the much larger size of the current analysis made it possible to examine diagnostic sub-groups in a way that could not be done meaningfully with smaller datasets. It also enabled comparison of prevalence rates across a large number of occupational groups in a diversity of countries.

Information was collected through a standardised questionnaire, and while in some occupational groups, interviews were used as an alternative to self-administration, there is no reason to expect that this would have differentially affected the reporting of localised neck/shoulder pain as compared with pain that was more generalised. Translation of the

questionnaire into local languages was checked by independent back-translation, and errors in reporting should have been further reduced by the use of pictures to define the anatomical areas of interest. In the cross-sectional analyses for Tables 2 and 3, there was a possibility of bias if experience of pain modified recall of occupational exposures; and also of reverse causation if, for example, neck/shoulder pain led to greater awareness of somatic symptoms. Moreover, the prevalence of pain may have been reduced through healthy worker selection. Again, however, there is no reason to expect major differences in such effects according to whether pain was localised to the neck and shoulder or more generalised.

The criteria by which we distinguished between LNSP and GPNS were to some extent arbitrary. Subject to the limits of participants' recall, they ensured that those with LNSP had not suffered from pain at other anatomical sites in the 12 months before baseline. However, it remains possible that this group included some people with a predisposition to pain at multiple sites which would have become manifest had they been studied over a longer period. Nevertheless, the case definitions were adequate to reveal important differences in epidemiological features. Some GPNS may have reflected radiation to the distal arm of pain that arose from primary pathology in the neck, but most participants with GPNS (93%) reported pain in the past 12 months in the low back and/or knees as well as any pain in the upper limb.

Several previous studies have documented the frequent co-occurrence of neck and shoulder pain [24], and also their association with pain in the lower back and at other anatomical sites [8,18,21]. However, we have been unable to identify any investigations that focused on pain limited only to the neck or shoulders.

Studies that have examined neck pain overall have found higher rates in women than men [21,23], and at older ages [21]. This is consistent with our findings for GPNS (which included most of the participants with neck pain in the past month at baseline). Moreover, pain that was localised entirely to the neck showed an even greater difference by sex (PRR 1.7, 95%CI 1.2–2.3). However, in contrast to GPNS, localised neck pain was less prevalent at older ages.

Many studies have examined the relationship of neck and/or shoulder pain to physical activities at work, associations being found most consistently with manual material handling [20] and awkward postures [2,20,24], including work with the hands above shoulder height [20]; and to a lesser extent with computer work [28]. We found that localised neck pain was more prevalent among participants who reported prolonged use of computer keyboards (PRR 1.9, 95%CI 1.5–2.4), and a borderline association of localised shoulder pain with prolonged elevation of the arms at work, but otherwise there were no clear relationships with physical activities for any of the pain outcomes examined. This may have been because within each occupational group, exposures to physical activities were fairly homogeneous, making it difficult to detect effects in analyses that adjusted for occupational group.

Homogeneity of exposures within occupational groups may also have limited our ability to discriminate associations with psychosocial aspects of work, which again have been implicated previously in the occurrence of neck and shoulder pain [16,21,24], although

mostly with estimates of relative risk less than two [16]. It was not possible to identify any clear differences between LNSP and GPNS, and although lack of support at work carried a higher risk of localised neck pain (PRR 1.5, 95%CI 1.1–2.0), this may have been a chance observation in the context of multiple testing.

In contrast, stronger associations were observed with somatising tendency and poor mental health. For poor mental health, which has been linked previously with neck pain [28], the relationship was limited to GPNS, while for somatising tendency it extended to localised pain, but was stronger for GPNS (PRR for ≥2 vs. 0 distressing somatic symptoms 1.6, 95%CI 1.5–1.8). The last finding is consistent with the earlier observation that within the CUPID study, somatising tendency is associated particularly with multi-site musculoskeletal pain [7]. It might be expected that people who are prone to worry about other common somatic symptoms, would also be more aware of musculoskeletal pain and more likely to report it. The weaker relationship to localised pain in the shoulder(s), suggests that the latter may be determined more by localised factors (e.g. pathology in the shoulder or health beliefs relating specifically to the shoulder).

The association that we observed between localised shoulder pain and adverse beliefs about the prognosis of arm pain (PRR 1.4 95%CI 1.0–2.1) may reflect a relationship more to the persistence than the incidence of symptoms. Prevalence depends upon both incidence and persistence, and our cross-sectional analysis could not distinguish between effects on one as compared with the other.

We also found marked differences in the prevalence of neck/shoulder pain by occupational group, and in the proportion of such pain that was localised to the neck/shoulder region (evidenced by the absence of clear positive correlation between the two categories of pain in Figure 1). The larger variation was for GPNS and tended to parallel that reported previously for disabling pain in the low back and wrist/hand regions [6]. This may be because, like neck/shoulder pain, most low back and wrist/hand pain occurs in people with a high susceptibility to musculoskeletal pain in general. The differences were somewhat reduced after control for known and suspected risk factors, but remained large. They might in part reflect differences in understanding of pain, across different cultures and especially between populations speaking different languages. However, such differences could not explain the variation between occupational groups in the proportion of neck/shoulder pain that was localised, which again was marked. The lack of correlation between the prevalence of LNSP and GPNS suggests differences in general predisposition to complain of musculoskeletal pain, perhaps culturally determined, that are not explained by differences in somatising tendency or other known or suspected risk factors for such pain. Whatever the explanation, the differential variation adds to the case for treating LNSP and GPNS as separate entities.

That case is further supported by the observation that in comparison with LNSP, GPNS tended to be more persistent at follow-up. This pattern would be expected if the general predisposition to pain that appears to drive rates of GPNS were a fairly unchanging personal characteristic, whereas LNSP was more influenced by transient factors such as reversible injuries to local tissues in the neck and shoulders.

In conclusion, our findings point to important distinctions between sub-categories of neck/shoulder pain. It is uncommon for people with neck/shoulder pain not to have experienced pain also at other anatomical sites during the past year, and those whose pain is limited to the neck and/or shoulders tend to be younger, to somatise less, and to be less disabled by their pain. Localised neck/shoulder pain is also less persistent than that which is associated with pain elsewhere, and shows stronger associations with occupational physical activities, perhaps reflecting specific effects on local tissues (e.g. muscle fatigue from postures associated with prolonged use of keyboards). In future research on neck/shoulder pain that bases case definitions only on symptoms, it would be useful to distinguish pain that is localised to the neck or shoulder from more generalised pain that happens to involve the neck/shoulder region as well as other parts of the body.

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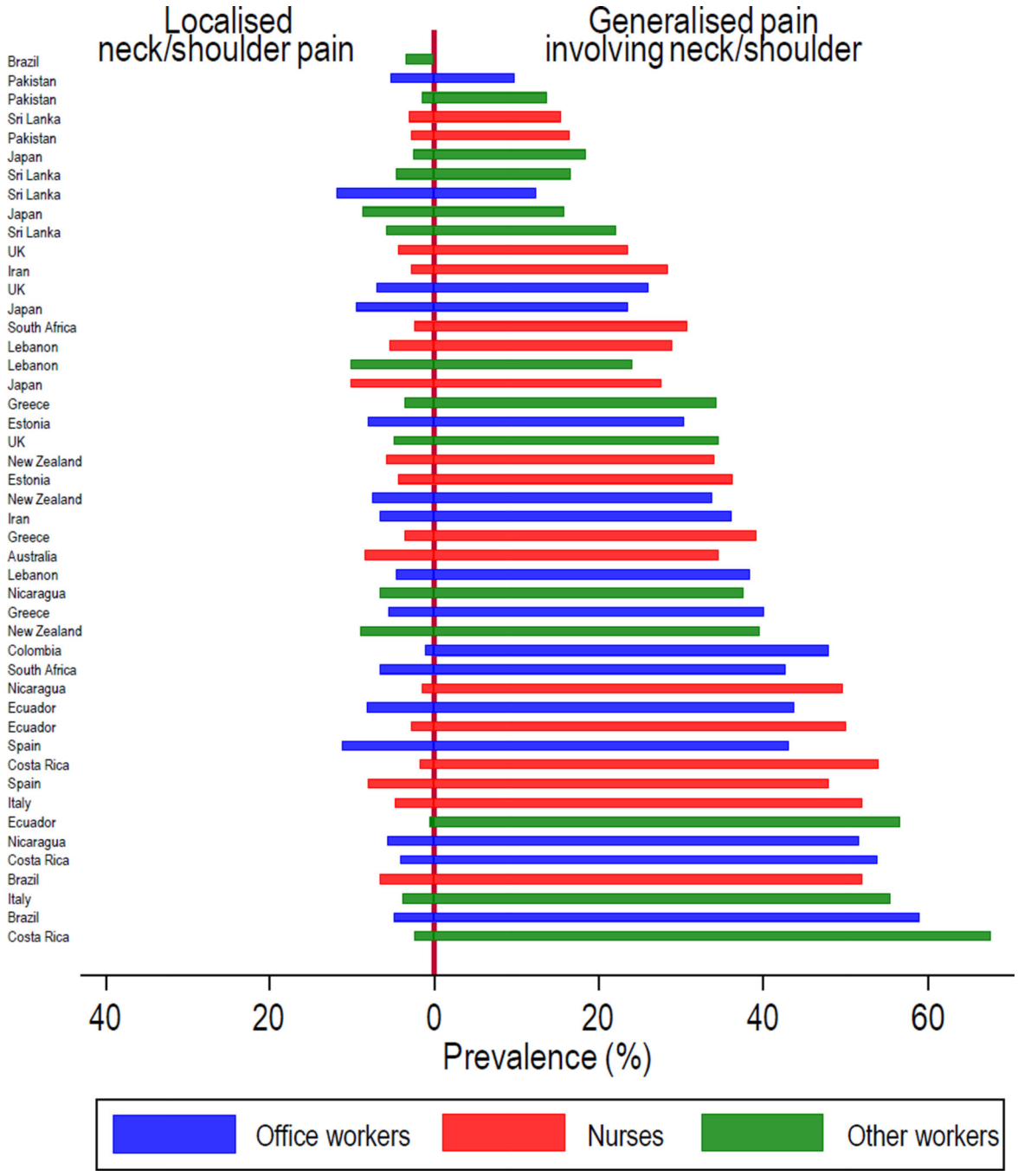

Figure 1.

Crude one-month prevalence of localised neck-shoulder pain and generalised pain involving neck/shoulder by occupational group

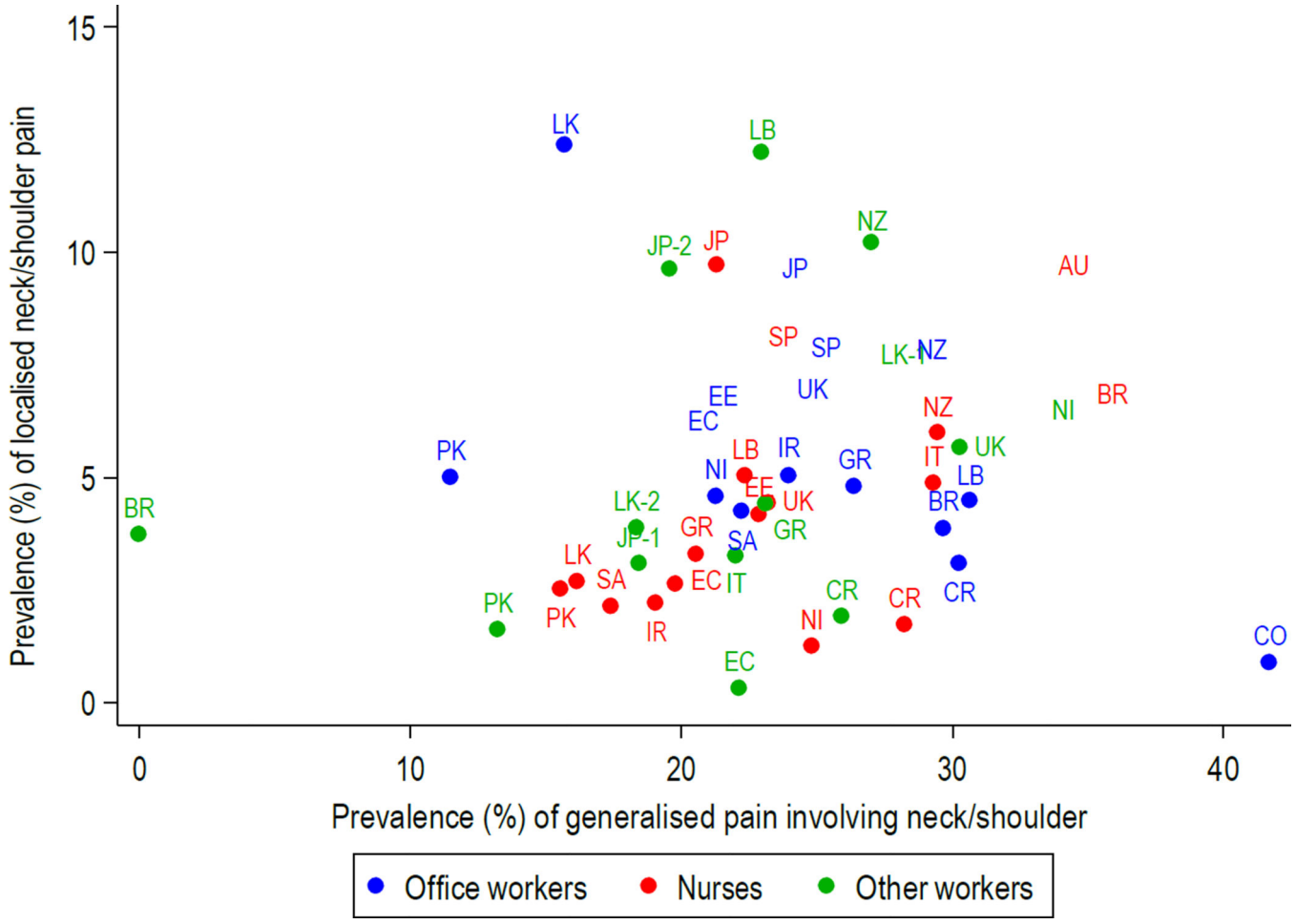

Figure 2.

Adjusted one-month prevalence of localised neck-shoulder pain and generalised pain involving neck/shoulder by occupational group

Prevalence rates are adjusted for all of the personal and occupational factors in Table 2 (see text)

Key to countries: AU Australia; BR Brazil; CO Colombia; CR Costa Rica; EC Ecuador; EE Estonia; GR Greece; IR Iran; IT Italy; JP Japan; LB Lebanon; LK Sri Lanka; NI Nicaragua; NZ New Zealand; PK Pakistan; SA South Africa; SP Spain; UK United Kingdom

Table 1

One-month prevalence and severity of different categories of neck/shoulder pain

Category of pain	Definition	Number of cases[a]	Prevalence per cent (95%CI)	Proportion per cent (95%CI)of cases in which pain			
				was present for >14 days in past month	was disabling in past month	led to medical consultation in past 12 months	caused absence from work in past 12 months
Localised neck pain	Pain in neck in past month, no pain elsewhere in past 12 months	302	2.5 (2.2,2.8)	18.5 (14.3,23.4)	23.8 (19.1,29.1)	35.1 (29.7, 40.8)	10.9 (7.6, 15.0)
Localised shoulder pain	Pain in one or both shoulders in past month, no pain elsewhere in past 12 months	152	1.2 (1.1, 1.5)	22.4 (16.0, 29.8)	48.0 (39.9, 56.3)	28.9 (21.9, 36.8)	12.5 (7.8, 18.8)
Localised neck/shoulder pain	Pain in neck and/or shoulder(s) in past month, no pain elsewhere in past 12 months	680	5.6 (5.2, 6.0)	24.0 (20.8, 27.4)	35.6 (32.0, 39.3)	38.2 (34.6, 42.0)	11.3 (9.0, 13.9)
Generalised pain involving neck/ shoulder	Pain in neck and/or shoulders in past month, with pain at other sites in past 12 months	4282	35.1 (34.3, 36.0)	30.5 (29.1, 31.9)	56.9 (55.4, 58.4)	49.1 (47.6, 50.6)	20.3 (19.1, 21.6)

[a]In addition, 5,344 participants had no neck or shoulder pain in the past 12 months, and 1,889 had neck and/or shoulder pain in the past 12 months, but not in the past month.

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Table 2

Associations of neck/shoulder pain with personal and occupational factors

Personal/occupational factor	Localised neck/shoulder pain			Generalised pain involving neck/shoulder		
	Number of cases	PRR[a]	(95%CI)	Number of cases	PRR[a]	(95%CI)
Sex						
Male	211 (7.9%)	1		1009 (29.1%)	1	
Female	469 (14.0%)	1.4	(1.1,1.7)	3273 (53.1%)	1.3	(1.2,1.4)
Age (years)						
20–29	180 (10.6%)	1		856 (36.0%)	1	
30–39	230 (11.8%)	1.1	(0.9,1.4)	1329 (43.6%)	1.2	(1.1,1.3)
40–49	193 (12.5%)	1.1	(0.9,1.4)	1327 (49.6%)	1.3	(1.1,1.4)
50–59	77 (9.3%)	0.8	(0.7,1.1)	770 (50.7%)	1.3	(1.2,1.5)
Activity in an average working day						
Lifting weights ≥25 kg	199 (9.4%)	0.9	(0.7,1.1)	1602 (45.5%)	1.1	(1.0,1.1)
Working with hands above shoulder height for >1 hour	177 (10.3%)	1.0	(0.9,1.3)	1508 (49.4%)	1.1	(1.1,1.2)
Use of keyboard for >4 hours	316 (15.6%)	1.3	(1.1,1.6)	1725 (50.2%)	1.1	(1.0,1.2)
Psychosocial aspects of work						
Work for >50 hours per week	140 (8.2%)	1.0	(0.7,1.2)	592 (27.5%)	0.9	(0.8,1.0)
Time pressure at work	485 (10.9%)	1.1	(0.9,1.3)	3350 (45.9%)	1.2	(1.1,1.2)
Incentives at work	188 (10.5%)	1.0	(0.9,1.2)	1140 (41.5%)	0.9	(0.9,1.0)
Lack of support at work	174 (15.4%)	1.1	(0.9,1.4)	1344 (58.5%)	1.1	(1.0,1.1)
Job dissatisfaction	146 (11.7%)	1.1	(0.9,1.4)	868 (43.9%)	1.0	(1.0,1.1)
Lack of job control	130 (10.3%)	1.0	(0.8,1.2)	963 (46.0%)	1.0	(0.9,1.1)
Job insecurity	195 (10.0%)	1.0	(0.9,1.1)	1331 (43.2%)	1.0	(1.0,1.1)
Number of distressing somatic symptoms in past week						
0	425 (9.9%)	1		1859 (32.4%)	1	
1	163 (15.1%)	1.3	(1.1,1.6)	1059 (53.6%)	1.4	(1.3,1.5)
2+	87 (14.8%)	1.3	(1.1,1.5)	1320 (72.4%)	1.6	(1.5,1.8)
Missing	5 (9.6%)	1.0	(0.3,3.0)	44 (48.4%)	1.3	(1.1,1.6)
Mental health						

Personal/occupational factor	Localised neck/shoulder pain			Generalised pain involving neck/shoulder		
	Number of cases	PRR[a]	(95%CI)	Number of cases	PRR[a]	(95%CI)
Good	265 (10.4%)	1		1311 (36.4%)	1	
Intermediate	216 (12.3%)	1.2	(0.9,1.4)	1333 (46.3%)	1.2	(1.1,1.3)
Poor	195 (11.7%)	1.1	(0.9,1.4)	1621 (52.5%)	1.3	(1.2,1.4)
Missing	4 (9.3%)	1.1	(0.5,2.5)	17 (30.4%)	0.8	(0.5,1.1)
Adverse beliefs about arm pain						
Work-relatedness	159 (11.4%)	1.1	(0.9,1.3)	1613 (56.6%)	1.2	(1.2,1.3)
Physical activity	62 (8.7%)	0.8	(0.6,1.0)	425 (39.5%)	0.8	(0.8,0.9)
Prognosis	69 (15.2%)	1.3	(1.0,1.5)	604 (61.0%)	1.1	(1.1,1.2)

[a]Prevalence rate ratios derived from a single Poisson regression model, with random intercept modelling to allow for clustering by occupational group. The reference group was participants with no pain in the neck or shoulders in the past 12 months (n =5344).

The denominators for percentages of cases are the total numbers of cases and referents with the relevant personal/occupational factor.

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Table 3

Associations of localised neck pain and localised shoulder pain with personal and occupational factors

Personal/occuptional factor	Localised neck pain			Localised shoulder pain		
	Number of cases	PRR[a]	(95%CI)	Number of cases	PRR[a]	(95%CI)
Sex						
Male	85 (3.3%)	1		58 (2.3%)	1	
Female	217 (7.0%)	1.7	(1.2,2.3)	94 (3.2%)	1.3	(0.9,1.8)
Age (years)						
20–29	96 (5.9%)	1		39 (2.5%)	1	
30–39	104 (5.7%)	1.0	(0.8,1.3)	44 (2.5%)	1.0	(0.7,1.5)
40–49	76 (5.3%)	0.9	(0.7,1.2)	46 (3.3%)	1.3	(0.8,2.0)
50–59	26 (3.4%)	0.6	(0.3,1.0)	23 (3.0%)	1.2	(0.7,1.8)
Activity in an average working day						
Lifting weights ≥25 kg	96 (4.8%)	0.9	(0.6,1.3)	42 (2.1%)	0.7	(0.5,1.2)
Working with hands above shoulder height for >1 hour	82 (5.0%)	1.0	(0.8,1.3)	50 (3.1%)	1.3	(1.0,1.8)
Use of keyboard for >4 hours	155 (8.3%)	1.9	(1.5,2.4)	53 (3.0%)	1.0	(0.7,1.4)
Psychosocial aspects of work						
Work for >50 hours per week	71 (4.3%)	1.2	(0.8,1.8)	35 (2.2%)	0.9	(0.5,1.5)
Time pressure at work	215 (5.2%)	1.0	(0.7,1.2)	117 (2.9%)	1.3	(0.9,2.0)
Incentives at work	92 (5.4%)	1.2	(0.9,1.5)	40 (2.4%)	0.8	(0.5,1.2)
Lack of support at work	92 (8.8%)	1.5	(1.1,2.0)	21 (2.2%)	0.7	(0.4,1.1)
Job dissatisfaction	63 (5.4%)	1.1	(0.8,1.3)	34 (3.0%)	1.3	(0.9,2.0)
Lack of job control	49 (4.2%)	0.7	(0.6,0.9)	33 (2.8%)	1.1	(0.7,1.7)
Job insecurity	104 (5.6%)	1.2	(1.0,1.5)	43 (2.4%)	0.9	(0.6,1.2)
Number of distressing somatic symptoms in past week						
0	179 (4.4%)	1		102 (2.6%)	1	
1	77 (7.7%)	1.5	(1.1,2.0)	28 (3.0%)	1.0	(0.7,1.5)
2+	45 (8.2%)	1.5	(1.1,2.1)	18 (3.5%)	1.2	(0.7,2.0)
Missing	1 (2.1%)	1	(0.1,7.7)	4 (7.8%)	2.2	(0.7,6.8)
Mental health						

Personal/occuptional factor	Localised neck pain			Localised shoulder pain		
	Number of cases	PRR[a]	(95%CI)	Number of cases	PRR[a]	(95%CI)
Good	117 (4.9%)	1		56 (2.4%)	1	
Intermediate	98 (6.0%)	1.2	(0.9,1.5)	50 (3.1%)	1.3	(0.8,2.1)
Poor	87 (5.6%)	1.1	(0.9,1.5)	43 (2.8%)	1.3	(0.8,2.1)
Missing	0 (0%)	0.0	(0.0,0.0)	3 (7.1%)	1.8	(0.6,5.3)
Adverse beliefs about arm pain						
Work-relatedness	66 (5.1%)	0.9	(0.7,1.3)	38 (3.0%)	1.1	(0.8,1.5)
Physical activity	28 (4.1%)	0.8	(0.5,1.2)	20 (3.0%)	1.1	(0.7,1.8)
Prognosis	23 (5.6%)	0.9	(0.7,1.3)	15 (3.7%)	1.4	(1.0,2.1)

[a]Prevalence rate ratios derived from a single Poisson regression model, with random intercept modelling to allow for clustering by occupational group. The reference group was participants with no pain in the neck or shoulders in the past 12 months (n = 5344).

The denominators for percentages of cases are the total numbers of cases and referents with the relevant personal/occupational factor.

Table 4

One-month prevalence of pain in neck and/or shoulders at follow-up by category of neck/shoulder pain at baseline

Category of pain at baseline	Number eligible for follow-up	Number (%) who completed follow-up	Same pain at follow-up			Number (%)[a] with pain in neck and/or shoulder(s) in past month at follow-up		
			Number	Percentage[a]	(95%CI)	Number	Percentage[a]	(95%CI)
Localised neck pain	289	219 (75.8)	123	56.2	(49.3, 62.8)	137	62.6	(55.8, 69.0)
Localised shoulder pain	148	113 (76.4)	36	31.9	(23.4, 41.3)	47	41.6	(32.4, 51.2)
Localised neck/shoulder pain	660	501 (75.9)				309	61.7	(57.3, 66.0)
Generalised pain involving neck/shoulder	4047	3253 (80.4)				2344	72.1	(70.5, 73.6)

Analysis was restricted to the 9150 cases with satisfactory information about neck/shoulder pain at follow-up

[a]Percentage of those who completed follow-up