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ORIGINAL ARTICLE

Individual and work related risk factors for neck pain among office workers: a cross sectional study

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Abstract Work related neck disorders are common problems in office workers, especially among those who are intensive computer users. It is generally agreed that the etiology of work related neck disorders is multidimensional which is associated with, and influenced by, a complex array of individual, physical and psychosocial factors. The aim of the current study was to estimate the one-year prevalence of neck pain among office workers and to determine which physical, psychological and individual factors are associated with these prevalences. Five hundred and twelve office workers were studied. Information was collected by an online questionnaire. Self-reported neck pain during the preceding 12 months was regarded as a dependent variable, whereas different individual, work-related physical and psychosocial factors were studied as independent variables. The 12 month prevalences of neck pain in office workers was 45.5%. Multivariate analysis revealed that women had an almost two-fold risk compared with men (OR = 1.95, 95% CI 1.22–3.13). The odds ratio for age indicates that persons older than 30 years have 2.61 times more chance of having neck pain than younger individuals (OR = 2.61, 95% CI 1.32–3.47). Being physically active decreases the likelihood of having neck pain (OR = 1.85, 95% CI 1.14–2.99). Significant associations were found between neck pain and often holding the neck in a forward bent posture for a prolonged time (OR = 2.01, 95% CI 1.20–3.38), often sitting for a prolonged time (OR = 2.06, 95% CI 1.17–3.62) and often making the same movements per minute (OR = 1.63, 95% CI 1.02–2.60). Mental tiredness at the end of the workday (OR = 2.05, 95% CI 1.29–3.26) and shortage of personnel (OR = 1.71, 95% CI 1.06–2.76) are significantly associated with neck pain. The results of this study indicate that physical and psychosocial work factors, as well as individual variables, are associated with the frequency of neck pain. These association patterns suggest also opportunities for intervention strategies in order to stimulate an ergonomic work place setting and increase a positive psychosocial work environment.

Keywords Neck pain · Risk factors · Office work · Work related · Psychosocial

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Introduction

Neck pain is common among adults in developed countries and contributes importantly to the demand for medical services and the economic burden of absence from work due to sickness. Population based studies suggest a lifetime prevalence of over 70% and a point prevalence of between 12 and 34% [3, 6–8, 20, 30, 31].

Several possible pathophysiological mechanisms of neck pain disorders have been proposed in the literature. According to Visser and Van Dieën [29], it

is unlikely that a single comprehensive pathophysiological mechanism exists that is responsible for tissue damage. Selective and sustained activation of type I motor units can be seen as the most influential hypothesis for the development of muscle damage due to sustained low-intensity tasks (the Cinderella hypothesis). This may lead to Ca^{2+} accumulation in the active motor units and other homeostatic disturbances due to limitations in local blood supply and metabolite removal in muscle compartment with larger numbers of active motor units. Additional mechanisms, such as nociceptor sentitization due to intra-muscular shear forces are also assumed to play a role [29].

Work related neck disorders are common problems in office workers, especially among those who are intensive computer users [5, 12, 14, 19, 22, 24, 25, 27]. The worldwide trend is for people to use computers for longer periods daily, due to increased computer-based tasks at work as well as during leisure activities. Introduction of the computer into the workplace has meant changes in work organization, and a different use of worker physical and mental potential. It is generally agreed that the etiology of work related neck disorders is multidimensional which is associated with, and influenced by, a complex array of individual, physical and psychosocial factors. Among these various risk factors, work-related psychosocial factors appear to play a major role. According to Ariëns et al. [2] work-related psychosocial variables may include aspects of the work content, organization, and interpersonal relationships at work, finances and economics. Individual factors are considered as confounding factors that influence the relation between psychosocial demands and the occurrence of neck pain. Furthermore, psychosocial demands may be highly correlated with physical demands, which also indicate a confounding effect of physical factors on the relation between work-related psychosocial variables and the occurrence of neck pain.

Several studies have been conducted in an attempt to identify risk factors for neck pain. However, most of these studies focus only on one or a few factors, and do not take physical factors, psychosocial factors and individual characteristics into account. Identifying factors that predispose individuals to persistent neck problems may contribute to primary or secondary prevention.

The aim of the current study was to estimate the one-year prevalence of neck pain among office workers and to determine which physical, psychological and individual factors are associated with these prevalences.

Materials and methods

Study design

The study was conducted among office workers in ten companies, consisting of 20–120 employees. The companies recruited were located throughout Belgium. The study base consisted of 720 computer users of which the major occupational categories were management/administration, medical secretary, graphic design, engineering and academic faculty.

The board of each company was asked to distribute an online self-administered questionnaire via email to their office workers. The mean time for filling out the forms was 20 min. The questionnaire was a shortened version of the standardized 'Dutch Musculoskeletal Questionnaire', which was found to be valid, whereas its reliability remains unknown [10, 11]. The questionnaire included various individual and work related factors (physical and psychosocial workload).

The study was approved by the local ethics committee at the University of Ghent.

Questionnaire

Dependent variable

The outcome was self-reported neck pain during the preceding 12 months. Neck pain was defined as pain in the head and neck region, shaded in a drawing of the head, neck and shoulder area (Fig. 1).

The four categories of the scale (never, once, regular, long-lasting) were dichotomized into healthy subjects (never or once) and neck pain patients (regular or long-lasting with episodes that lasted for at least 1 day during the previous 12 months). Separate questions solicited the relation between the current job and the neck complaints and asked for activity limitation,

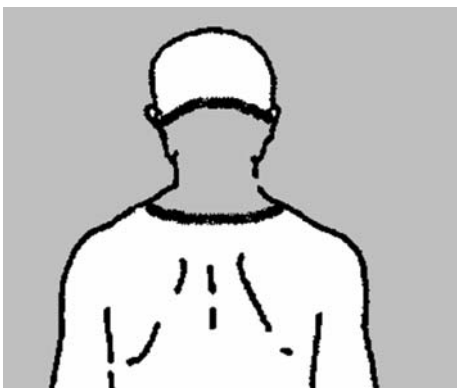

Fig. 1 Drawing of the head, neck and shoulder area with a *shaded head* and *neck region* indicating 'neck pain'

difficulties in performing activities at work or during leisure time and sick leave due to neck pain.

Independent variables

Several variables were considered in the analyses:

Individual factors: the following individual characteristics were considered to be potential confounders: gender, age, height and weight from which body mass index was subsequently calculated, marital status, formal education, smoking, sleeping hours and leisure time (sport and hobby).

Work related physical factors: were assessed by questions about the duration of employment (years at current job, hours a week, days a week); physical tiredness at the end of the day; physical workload (postures, movements and forces related to the neck region) (nine questions); computer use; breaks during work (five questions); and climatological conditions (noise, lack of fresh air, dry air, changes of temperature, stench);

Work related psychosocial factors: mental tiredness at the end of the day; job pressure (seven questions); work variation (seven questions) and job satisfaction (11 questions) aiming at evaluating demands, control and autonomy at work, work organization and social support.

Statistical analysis

The data were analysed using the statistical package for the social sciences (SPSS) software (version 12.0). The results have been reported as descriptive statistics.

The association between dependent and independent variables was analyzed. Univariate and multivariate analyses were performed to identify risk factors. Differences between groups were calculated through cross-tabulations or an independent sample's *t*-test. The odds ratio (OR) was calculated and a 95% confidence interval was applied. All variables associated with neck pain in univariate analysis with a *P*-value < 0.15 were entered into a logistic regression model. Forward stepwise was used in the present study. Forward selection begins with no predictors in the regression equation. The predictor variable that has the highest correlation with the criterion variable is entered into the equation first. The remaining variables are entered into the equation depending on the contribution of each predictor.

Results

Description of the study sample

A total of 720 questionnaires were distributed of which 512 responded (71.1%). The response rate of the different companies varied from 61.5 to 83.7%.

Tables 1 and 2 show the basic characteristics of the study population. Two hundred and twenty five women (41.7%) and two hundred and eighty seven men (58.3%) participated of which 30.1% were younger than 30, 29.7% were between 30 and 39; 26.9% between 40 and 49 and 13.3% were older than 50 years of age. The mean duration of employment was 10.6 years with a mean of 39 working hours per week.

No significant differences between the 10 companies with respect to the dependent and independent variables were found.

Dependent variable: neck complaints

A total of 45.5% of the population reported neck pain in the past 12 months, of which 18.1% complaint of continuous pain. A total of 64.3% of the patients reported that there was a relation between their current job and the neck complaints. A total of 56.2% even mentioned that their complaints started during the current job. A total of 10.2% reported sick leave due to neck complaints. The work place and equipment were adapted in 24% of the patients due to neck pain. Work time was changed due to the same reason.

Associations between independent variables and neck complaints

Tables 3, 4, 5 show the prevalence, odds ratio and 95% CI of neck complaints of all significant individual, work related physical and psychosocial factors.

Table 1 Descriptive statistics (mean ± SD) of individual characteristics among female and male office workers

	Women (n = 225)	Men (n = 287)	Total (n = 512)
Weight (kg)	63.8 (10.8)	80.5 (11.9)	73.1 (14.1)
Height (cm)	167.1 (6.4)	179.5 (6.5)	174.0 (8.9)
BMI (kg/m^2)	22.8 (3.3)	24.9 (3.2)	24.0 (3.4)
Employment in current job (years)	10.4 (9.0)	10.8 (9.4)	10.6 (9.3)
Working hours per week (h/week)	35.7 (11.2)	41.5 (11.5)	39.0 (11.7)

Table 2 Distribution of age groups among female and male office workers

	Women (n = 225)	Men (n = 287)	Total (n = 512)
Age			
18–29	74 (32.9%)	80 (27.9%)	154 (30.1%)
30–39	62 (27.6%)	90 (31.3%)	152 (29.7%)
40–49	57 (25.3%)	81 (28.2%)	138 (26.9%)
50–59	32 (14.2%)	36 (12.6%)	68 (13.3%)

Table 3 Distribution of the subjects into healthy and neck pain patients according to self-reported individual risk factors

	Healthy		Neck pain		P-value	OR	95% CI
	n	%	n	%			
Age							
18–29	111	72.1	43	27.9	0.001		
30–39	73	48.0	79	52.0		2.79	1.74–4.49
40–49	59	42.8	79	57.2		3.46	2.19–5.84
50–59	36	52.9	32	47.1		2.29	1.26–4.16
Gender							
Male	177	61.7	110	38.3	0.001		
Female	102	45.3	123	54.7		1.94	1.3–2.77
Sport							
No	85	43.3	111	56.7	0.001		
Yes	194	61.4	122	38.6		2.08	1.49–3.16

Individual factors

Women had an almost twofold risk compared with men (OR = 1.94, 95% CI 1.30–2.77) (Table 3). There were also statistically significant differences in the reporting of persistent neck pain across different age categories with the highest likelihood of pain being among those 40–49 years of age (OR = 3.46, 95% CI 2.19–5.84). Subjects younger than 30 reported significantly less neck pain than older subjects (older than 30 years of age). Not being physically active increased the risk of neck pain (OR = 2.08, 95% CI 1.49–3.16).

Marital status, formal education, cigarette smoking and sleeping hours were not linked to the likelihood of subsequent neck pain.

Work related physical factors

Analyses of the association between neck pain and work related physical factors, revealed that neck pain was significantly associated with often holding the neck in a forward bent posture for a prolonged time (OR = 2.66, 95% CI 1.56–3.57), various short periods of movements with the neck (OR = 2.07, 95% CI 1.32–3.01), often working in the same position for a prolonged time (OR = 2.79, 95% CI 1.72–4.00), often making the same movements per minute (OR = 2.05, 95% CI 1.39–2.94), often sitting for a prolonged time (OR = 1.98, 95% CI 1.12–2.78), dry air (OR = 1.94, 95% CI 1.28–2.70) and temperature fluctuation (OR = 1.74, 95% CI 1.14–2.56), and computer working time (OR = 1.57, 95% CI 1.10–2.22) (Table 4).

Table 4 Distribution of the subjects into healthy and neck pain patients according to self-reported work related physical factors

	Healthy		Neck pain		P-value	OR	95% CI
	n	%	n	%			
Often holding the neck in a forward bent posture for a prolonged time							
No	231	60.6	150	39.4	< 0.001		
Yes	48	36.6	83	63.4		2.66	1.56–3.57
Various short periods of movements with the neck							
No	227	59.0	158	41.0	0.001		
Yes	52	40.9	75	59.1		2.07	1.32–3.01
Often working in the same postures for a prolonged time							
No	119	70.8	49	29.2	0.001		
Yes	160	46.5	184	53.5		2.79	1.72–4.00
Often making the same movements per minute							
No	195	60.9	125	39.1	0.001		
Yes	82	43.2	108	56.8		2.05	1.39–2.94
Often sitting for a prolonged time							
No	88	66.7	44	33.3	0.013		
Yes	191	50.3	189	49.7		1.98	1.12–2.78
Experiencing dry air							
No	190	60.9	122	39.1	0.001		
Yes	89	44.5	111	55.5		1.94	1.28–2.70
Experiencing changes of temperature							
No	222	58.0	161	42.0	0.010		
Yes	57	44.2	72	55.8		1.74	1.14–2.56
Computer working time							
< 4 h/day	145	60.4	95	39.6	0.013		
> 4 h/day	134	49.3	138	50.7		1.57	1.10–2.22

Table 5 Distribution of the subjects into healthy and neck pain patients according to self-reported work related psychosocial factors

	Healthy		Neck pain		*P*-value	OR	95% CI
	n	%	*n*	%			
Mental tiredness at the end of the workday							
None/little	168	66.7	84	33.3	< 0.001		
Fairly much/much	111	42.7	149	57.3		2.68	1.81–3.78
Shortage of personnel							
No	204	59.6	138	40.4	0.003		
Yes	75	44.1	95	55.9		1.87	1.20–2.56
Being rested after break							
Yes	221	61.2	140	38.8	< 0.001		
No	58	38.4	93	61.6		2.53	1.65–3.67
Variation at work							
Yes	254	58.5	180	41.5	< 0.001		
No	25	32.1	53	67.9		2.99	1.7–4.77
Doing the same work all day							
No	150	62.0	92	38.0	0.005		
Yes	129	47.8	141	52.2		1.78	1.16–2.44
Getting annoyed about others							
No	219	59.8	147	40.2	< 0.001		
Yes	60	41.1	86	58.9		2.14	1.39–3.03

Work related psychosocial factors

The following work related psychosocial factors showed a positive association with neck pain: mental tiredness at the end of the workday (OR = 2.68, 95% CI 1.81–3.78); shortage of personnel (OR = 1.87, 95% CI 1.20–2.56); not being rested after break (OR = 2.53, 95% CI 1.65–3.67); no variation at work (OR = 2.99, 95% CI 1.70–4.77); doing the same work all day (OR = 1.78, 95% CI 1.16–2.44); getting annoyed about others (OR = 2.14, 95% CI 1.39–3.03) (Table 5).

Multivariate analysis

It is plausible that the baseline factors significantly associated with subsequent neck pain are not independent of each other. Hence, all the baseline variables, which were significantly associated with neck pain, were next explored for their independent association with neck pain outcome at 12 months in a multivariate logistic regression. Individual, as well as physical and psychosocial work related factors variables were found to be independently associated with prevalence of neck pain (Table 6). This model accounted for 25% of the variability in productivity outcome (R[2]-Nagelkerke = 0.25).

Women have an almost two-fold risk compared with men (OR = 1.95, 95% CI 1.22–3.13). The odds ratio for age indicates that persons older than 30 years have 2.61 times more chance of having neck pain than younger individuals (OR = 2.61, 95% CI 1.32–3.47). Being physically active decreases the likelihood of having neck pain (OR = 1.85, 95% CI 1.14–2.99).

Often holding the neck in a forward bent posture for a prolonged time (OR = 2.01, 95% CI 1.20–3.38), often sitting for a prolonged time (OR = 2.06, 95% CI 1.17–3.62) and often making the same movements per minute (OR = 1.63, 95% CI 1.02–2.60) are risk factors for neck pain.

The risk of neck pain is about two-fold for those experiencing mental tiredness at the end of the workday in comparison to those who do not experience tiredness (OR = 2.05, 95% CI 1.29–3.26). Shortage of personnel increases the risk of neck pain (OR = 1.71, 95% CI 1.06–2.76).

Discussion

In this study among office employees working with computers in different settings, we found that neck pain was associated with both work related (psychosocial and physical), and individual factors.

Different studies have taken physical and psychosocial job factors into account when studying neck pain. Overall, both physical and psychosocial work factors were related to neck pain, although variables significantly associated with neck pain were different between studies.

Neck complaints

In this cross-sectional study, we found high prevalences for neck pain: 45.5% of the respondents reported prevalent neck pain. The prevalence of neck pain during the past 12 months in the present study is in

Table 6 Odds ratios for predictors of neck pain among office workers (Logistic regression model)

Predictor	B	Wald X^2	*P*-value	Odds ratio	95% CI
Gender	0.669	7.761	0.005	1.95	1.22–3.13
Age	0.961	8.952	0.003	2.61	1.32–3.47
Sport	0.613	6.150	0.013	1.85	1.14–2.99
Often holding the neck in a forward bent posture for a prolonged time	0.698	6.941	0.008	2.01	1.20–3.38
Often sitting for a prolonged time	0.723	6.279	0.012	2.06	1.17–3.62
Often making the same movements per minute	0.486	4.157	0.041	1.63	1.02–2.60
Mental tiredness at the end of the workday	0.716	9.083	0.003	2.05	1.29–3.26
Shortage of personnel	0.537	4.802	0.028	1.71	1.06–2.76

agreement with other studies [8, 14, 16, 17, 20, 21, 27]. Other studies on office workers have reported both higher [22] and lower prevalences of neck pain [16]. The differences between studies could be due to differences in populations studied, the time periods used in the period prevalence calculations, or in the criteria used for defining pain or symptoms.

The response rate could be considered high (71.1%), since the questionnaire was distributed only once, without reminders. However, the present results must be viewed within the limitations of the study. A possible selection bias from a healthy workers effect cannot be excluded. Moreover, since the analyses were limited to currently working subjects, we may have excluded workers who had left the job market because of musculoskeletal pain. Another possibility of a selection bias exists if eligible workers who did not participate were different from those who completed the survey. The effects of these potential selection biases could not be evaluated, but the mean duration of employment in the current job of more than 10 years suggests that the study was conducted in a reasonably stable population. Hence, it is expected that selection bias will not have influenced the observed associations to a great extent. However, one needs prospective studies to corroborate the observed associations.

As subjects had to report neck pain that occurred during the past 12 months, some people could have under-reported pain due to difficulty to recall; therefore, these prevalences could have been under estimated. On the other hand, subjects with neck pain might rate their exposure higher than those without complaints. This is especially true when using self-reported data [27].

Associations between independent variables and neck complaints

As in most studies, significant relationships were found between self-reported risk factors and the occurrence of neck pain. The cross-sectional design of this study however does not permit causal inference from the observed associations.

Individual factors

The prevalence of neck pain was substantially higher among women (18%) than among men (11%), which is consistent with previous studies [16, 17, 28]. This gender pattern is seen in most types of body pain and several sociological, cultural and physical differences have been proposed as explanations, but these hypotheses have not been shown to be satisfactory [8]. Smaller stature and lower strength of the shoulder muscles have been suggested to partly explain the sex difference [16]. Concerning computer work in particular, gender differences have been found, for example, in the use of a computer mouse. Women are working with higher relative musculoskeletal load, for instance, applying higher forces to the mouse and using greater rang of motion, than are men. Additionally, women are known to report more symptoms than men [22].

A reversed U-shaped association was found between age and the prevalence of neck pain. The risk of neck pain increased until the age of 50 and decreased slightly thereafter. This is in line with earlier studies [4, 17, 28]. The increase with age can be understood by increasing degeneration of the cervical spine with age. The decrease of neck pain in the oldest age group is more difficult to explain. One explanation could be that chronic diseases and other ailments may gain the upper hand [4].

Being physically active decreases the likelihood of having neck pain. Korhonen et al. [16] found in their cohort study that employees who exercised less frequently demonstrated a higher risk of neck pain. This may have some clinical implications: as concluded by Hildebrandt et al. [9], stimulation of leisure time physical activity may constitute one of the means of

reducing musculoskeletal morbidity in the working population, in particular in sedentary workers.

Work related physical factors

Often holding the neck in a forward bent posture for a prolonged time, and often working in the same position for a prolonged time were significantly associated with neck pain. Ariens et al. [2] found a trend for a positive relation between neck flexion and neck pain, although not significant, suggesting an increased risk of neck pain for those who spent a high percentage of the working time with the neck at a minimum of 20° of flexion.

Often making the same movements per minute was significantly associated with neck pain. When performing work with the hands and fingers, the muscles in the neck/shoulder region must usually act as stabilizers. Static contraction of the trapezius and other shoulder muscles is needed to keep the arms at right angles, a necessary posture when using the keyboard. This contraction is accentuated when there is also rotation or bending of the neck when the computer screen is placed to the side of the worker, not in front which is the recommended position. However, Szeto et al. [26] attributed changing muscle patterns to reflect more the subjects' personal habitual movements and postures rather than the influence of their workstations.

A significant positive relation was found between sitting posture and neck pain. The results of the present study confirm previous findings [2, 15, 23]. Ariëns et al. [2] found that workers who sat for more than 95% of the working time the risk of neck pain was twice as high as for worker who hardly ever worked in a sitting position. Skov et al. [23] found that the odds ratios for neck pain increased with the time spent working in a sitting position, suggesting a clear relation between sitting posture and neck pain. Kamwendo et al. [15] reported an odds ratio of 1.49 for the relation between sitting for more than 5 hours a day and self reported neck pain. According to Ortiz-Hernandez et al. [19], remaining seated for long periods, usually accompanied by curvature of the spine, increases pressure on vertebral discs, ligaments, and muscles.

Some climatological conditions (dry air and temperature fluctuation) seem to be a significant predictor in our data. This is in agreement with the study of Korhonen et al. [16] who found a positive association between the different aspects of physical work environment and neck pain. Rocha et al. [21] demonstrated that inadequate thermal comfort was associated with neck symptoms. The variables of the climatological conditions were self reported. There is a possibility of bias as subjects with neck pain may have a different perception of their work environment.

Analyses of the association between neck pain and work related physical factors, revealed that neck pain was significantly associated with computer working time. Previous results are inconsistent about this association [5, 12, 13, 16, 18]. One should take into account that the time used for computer work was measured as self reported proportion of total working time, which may result in overestimation of the time spend on the computer [16].

Work related psychosocial factors

Different work related psychosocial factors showed a positive association with neck pain, but only mental tiredness at the end of the day and shortage of personnel were independently related. Reporting shortage of personnel may be an indirect reflection of work (over) load. There is consistent evidence that stress is associated with neck pain in both cross sectional and longitudinal studies [1, 17, 28].

The protective effect of rest breaks observed in this study was also reported in other studies [19]. Breaks allow a reduction in computer exposure, but more especially permit muscle relaxation.

The study results suggest that effective intervention strategies aiming at reducing the occurrence of neck pain most likely have to take into account both ergonomic improvements and cognitive behavioural aspects. Based on the results of this study, intervention should be applied to reduce computer exposure and also toward improving ergonomic conditions. Dynamic and sit/stand chairs will lead to more variation in posture and comfort. The use of document holders, a correct placement of the screen and adjustable chairs will reduce the neck load. Compulsory rest breaks could be introduced to reduce computer use.

However, to date, the preventive effectiveness of neck schools, based predominantly upon ergonomic principles, is not convincing. Therefore, future research should focus on evaluation programs for workplace prevention strategies aimed at reducing both mechanical and psychosocial risk factors.

Conclusion

The results of this study indicate that physical and psychosocial work factors, as well as individual variables, are associated with the frequency of neck pain. These association patterns suggest also opportunities for intervention strategies in order to stimulate an

ergonomic work place setting and increase a positive psychosocial work environment.

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