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Risk factors for neck pain: a longitudinal study in the general population

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Abstract

The objective of the study was to examine the 1-year cumulative incidence of episodic neck pain and to explore its associations with individual risk factors, including a history of previous neck injury. A baseline cross-sectional survey of an adult general population sample made up of all 7669 adults aged 18–75 years, registered with two family practices in South Manchester, United Kingdom, identified the study population of adults with no current neck pain. This study population was surveyed again 12 months later to identify all those who had experienced neck pain during the follow-up period. At follow-up, cumulative 1-year episode incidence of neck pain was estimated at 17.9% (95% confidence interval 16.0–19.7%). Incidence was independent of age, but was more common in women. A history of previous neck injury at baseline was a significant risk factor for subsequent neck pain in the follow-up year (risk ratio 1.7, 95% confidence interval 1.2–2.5), independent of gender and psychological status. Other independent baseline risk factors for subsequent neck pain included number of children, poor self-assessed health, poor psychological status and a past history of low back pain. We have carried out a prospective study in a general population sample and demonstrated that established risk factors for chronic pain predict future episodes of neck pain, and shown that in addition a history of neck injury is an independent and distinct risk factor. This finding may have major public health and medicolegal implications.

Keywords: Neck pain; Incidence; Mass screening; Follow-up study; Risk factor; Neck injury

1. Introduction

Neck pain is common. In European and North American populations about one-third of adults will experience neck pain in the course of 1 year, and about 5–10% of adults will have a significantly disabling neck problem (Bovim et al., 1994; Cote et al., 1998). The prevalence is higher in women and rises with age (Andersson et al., 1993; Bovim et al., 1994; Cote et al., 1998), and cultural variation is suggested by a lower reported prevalence in Asian populations (Lau et al., 1996). In cross-sectional studies neck pain has been associated with self-reported poor general health status, psychological distress, and previous neck injury, in addition to a range of other factors such as occupational tasks and obesity (Makela et al., 1991; Ariens et al., 1999; Fredriksson et al., 1999). A recent occupational cohort study has confirmed that psychosocial factors and a previous history of pain are important predictors of incident neck pain (Leclerc et al., 1999). Many of these associations are not specific to neck pain but are found in relation to regional pain syndromes generally (Makela et al., 1991).

The suggestion has been made that acute musculoskeletal syndromes reflect the nature and site of injury, inflammation or infection, whereas chronicity is further determined by cultural and psychosocial factors irrespective of the nature of the original acute problem. In the case of the neck, the role of traumatic injury (notably whiplash injury) in the genesis of chronic pain has been widely debated. The total prevalence of neck pain observed in general population samples (Bovim et al., 1994) is similar to the prevalence of neck pain reported in follow-up studies of unselected populations of injured subjects (Schrader et al., 1996), suggesting that the occurrence of chronic neck pain is no different in those who have experienced trauma to the neck than in those who have not. However cross-sectional studies also consistently report that recalled injury is more common

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in those with neck pain (Marshall et al., 1995), whilst follow-up studies of selected groups of neck-injured patients suggest that their risk of developing chronic neck pain is high (Gotten, 1956; Deans et al., 1987).

There are three problems with the interpretation of associations from cross-sectional studies. First, the direction of cause and effect is difficult to establish. For example, psychological distress may be a risk factor for persistent neck pain, but it is equally likely that persistent pain will give rise to psychological distress. Second, the presence of pain at the time of the study may influence recall. For example, a past history of neck injury may be more likely to be recalled by those currently suffering from neck symptoms. Third, cross-sectional measures of prevalence will over-represent chronic problems, so that the reported associations may relate to general propensities toward developing chronic or persistent symptoms rather than to an increased incidence of the specific problem.

We have conducted a prospective study of adults from a general population sample who were initially free of neck pain, in order to determine risk factors for developing new or recurrent episodes of neck pain, including an investigation of whether a history of neck injury is an independent risk for later neck pain.

2. Methods

The design was in two phases: (i) a baseline cross-sectional survey of an adult general population sample to identify the study population and (ii) a follow-up survey, 12 months later, of baseline responders who had reported no current neck pain at baseline (the incidence study).

In 1992 the survey in the first phase was mailed to all 7669 adults, aged 18–75 years, registered with two family practices in South Manchester, United Kingdom. This population has previously been described in relation to a survey of low back pain (Papageorgiou et al., 1995). It was a socially mixed group, with a proportion of manual labourers and unemployed workers (28%) that was higher than the United Kingdom national average. Available for the study was a computerized register of the practice populations, categorized by age and sex, which included current presumed addresses. In the United Kingdom, more than 95% of the population are registered with a family practitioner. Such registers are not reliant on actual attendance at the practice and thus are convenient sampling frames to represent local populations.

The baseline survey consisted of a questionnaire, which was mailed to the study population together with a letter of support signed by the family practitioner. It included a question about neck pain, accompanied by a manikin of the head, neck and shoulder area, with an area shaded as in Fig. 1. The question asked 'Thinking back over the PAST MONTH, have you had any NECK PAIN in the area shown which lasted for more than 1 day; yes or no?'. Those subjects who, according to their answer to this question, had not had neck pain in the month prior to the baseline survey, formed the study population for the incidence study.

Other questions in the baseline instrument characterized further this cohort of adults free of neck pain at the time of the survey. This included enquiry about a previous history of neck injury and its date of occurrence. One asked: 'Have you ever injured your neck; yes or no?', and a second followed on by asking 'If yes, how old were you when this happened?'. Other questions related to age, gender, current and past smoking status, current alcohol status, current occupational status, marital status and number of children, together with a measure of social class (car ownership) which had been used previously in social surveys in the North of England (Office of Population Censuses and Surveys, 1992). Weight and height were based on self-report, a method previously validated in a subsample of this population (Thomas et al., 1995), and body mass index (kg/m^2) was calculated and categorized into quartiles based on its distribution in all baseline study responders.

An overall measure of self-reported health status (on a 4-point scale) was included ('Would you say that, compared with others of the same age, your own health in general is: excellent; good; fair; poor?'). The measure of psychological distress was the 12-item version of the General Health Questionnaire, an instrument designed to identify psychological distress, and which is a screening instrument for mental illness, previously validated in general population samples (Goldberg and Williams, 1988).

The study population of neck pain-free adults was followed up 12 months later using a second postal question-

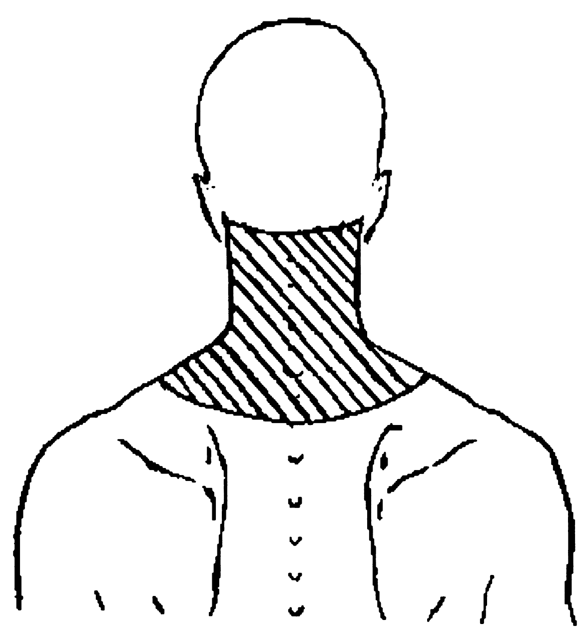

Fig. 1. Shaded manikin (neck area) used in baseline and 12-month follow-up questionnaires to screen for neck pain in a Manchester adult population sample, 1992–1993.

naire. The question which defined neck pain in this follow-up survey was 'Thinking back over the PAST 12 MONTHS, have you had NECK PAIN in the area shown which lasted for more than 1 day; yes or no?'. The same shaded manikin was used as in the baseline survey (Fig. 1). The cumulative incidence of neck pain in the population who responded to the follow-up survey was then estimated on the basis of the answers to this question. For the purposes of this study, this cumulative incidence was defined as 'the proportion of all people free of neck pain at the time of the baseline survey who developed neck pain at any time during the follow-up year', i.e. repeated episodes during the follow-up year were not additionally identified or counted.

Statistical analysis was carried out using the chi-square test, a trend test being used for ordinal variables. Baseline predictor variables were categorized to allow calculation of risk ratios (RR), together with 95% confidence intervals (CI), for developing neck pain, based on the 1-year cumulative incidence of the latter. Tests for trend of relative risk across categories were performed using chi squared tests on 1 degree of freedom (df). As well as unifactorial analysis, we also accounted for confounding by adjusting for age and gender using logistic regression. Odds ratios were converted to risk ratios by the methods of Osborn and Cattaruzza (1995). All predictor variables that were significantly associated with neck pain statistically on univariate analysis were entered into a final logistic regression to assess the multivariate outcome for neck pain. Statistical significance is quoted for values of $P < 0.05$, and all hypothesis testing was two-tailed. All analyses were carried out using SPSS version 9.0.

Non-response to questionnaires might have introduced bias at both stages of our study design. At baseline, those who responded to the survey might have been systematically different to those who did not respond. More importantly, those of our selected study cohort who did not participate at the 12-month follow-up might have differed with respect to incidence and risk of neck pain from those who did not participate. We investigated these potential biases in three ways. First, we compared the age and gender distribution of baseline responders and non-responders, and used this analysis to estimate the likely age and gender distribution of subjects free of neck pain in the total survey sample. We then standardized our incidence estimates to this population. Second, we compared responders to the baseline survey across the three 'waves' of response. We had mailed up to two reminders within a 6-week period to all those who did not initially return a baseline questionnaire. We thus compared incidence within the prospective study cohort across the three categories of baseline response 'waves'. Third, we compared the age, gender, and risk factor distribution in the prospective cohort between those who did and did not participate at 12 months, and directly standardized our incidence estimates for any differences.

3. Results

3.1. Response

There were 4501 responders to the baseline questionnaire, a response of 58.7%, of whom 4393 answered the question addressing neck pain. After allowing for those who did not receive a questionnaire because they had moved from the address on the register, the adjusted response was 65%. A total of 3034 adults did not have current neck pain and formed the study population for the prospective incidence study. A small number ($n = 192$) who consulted their general practitioner during the subsequent 12 months because of low back pain were recruited into a study of low back pain and did not participate in phase 2 of the neck pain study. All the remaining 2842 subjects were mailed a follow-up questionnaire 12 months after the baseline survey. There were 1776 replies, of whom 1708 responded to the question addressing neck pain, an overall response of 60.1%; 1403 adults had continued free of neck pain, whilst 305 recalled suffering neck pain in the period between the two surveys, giving an overall estimated annual

Table 1
Twelve-month cumulative incidence of neck pain in 1708 follow-up responders free of neck pain at baseline, stratified by age and gender (Manchester adult population sample, 1992–1993)

Factor	Category	Total number	Number with pain	Crude incidence % (95% CI)[a]	RR (95% CI)[a]
All responders	–	1708	305	17.9 (16.0–19.7)	–
Age (years)	18–29[b]	365	60	16.4 (12.6–20.2)	1.0
	30–44	479	95	19.8 (16.3–23.4)	1.2 (0.9–1.6)
	45–59	316	60	19.0 (14.7–23.3)	1.2 (0.9–1.7)
	60–75	548	90	16.4 (13.3–19.5)	1.0 (0.8–1.4)
Gender[c]	Male[b]	712	109	15.3 (12.7–18.0)	1.0
	Female	996	196	19.7 (17.2–22.1)	1.3 (1.0–1.6)

[a] CI, confidence interval; RR, relative risk adjusted for age or gender as appropriate.
[b] Reference category.
[c] Significant linear trend ($P < 0.05$) between incidence of neck pain and the predictor variable after adjusting for age or gender as appropriate.

cumulative incidence of neck pain of 17.9% (95% CI: 16.0--19.7%).

3.2. Age and gender

The 1-year cumulative incidence of neck pain showed little fluctuation across age groups ($\chi^2 = 0.15$, 1 df, $P = 0.700$), but figures were higher for women than men ($\chi^2 = 5.41$, 1 df, $P = 0.020$) (Table 1).

3.3. Constitutional, social and lifestyle factors

Certain social groups do appear to be at higher risk of developing neck pain (Table 2). In general terms, being in employment or not at the time of the baseline survey, or owning a car or not, were not linked to the likelihood of subsequent neck pain ($P > 0.05$). However, the group who were unable to work because of ill health or disability at baseline did have a higher incidence of neck pain in the follow-up year (RR 1.9 adjusted for age and sex (95% CI: 1.2–2.9)) compared with those working full time. Being separated, divorced or widowed, was linked with a higher incidence of neck pain compared with married or single adults.

There was a clear and significant linear trend of increas-

Table 2
Twelve-month cumulative incidence of neck pain in 1708 follow-up responders free of neck pain at baseline, stratified by baseline social, behavioural and health factors (Manchester adult population sample, 1992–1993)[a]

Factor	Category	Total number	Number with pain	Crude incidence % (95% CI)	RR (95% CI)
Marital status	Single[b]	339	52	15.3 (11.5–19.2)	1.0
	Married or partner	1055	181	17.2 (14.9–19.4)	1.2 (0.9–1.6)
	Separated	27	6	22.2 (8.6–42.3)	1.5 (0.7–3.3)
	Divorced	125	26	20.8 (13.7–27.9)	1.4 (0.9–2.2)
	Widowed	156	38	24.4 (17.6–31.1)	1.8 (1.1–2.8)
Children[c]	None[b]	504	72	14.3 (11.2–17.3)	1.0
	One	247	44	17.8 (13.0–22.6)	1.3 (0.9–1.8)
	Two	464	82	17.7 (14.2–21.1)	1.3 (1.0–1.7)
	Three	241	49	20.3 (15.3–25.4)	1.5 (1.1–2.1)
	Four or more	197	44	22.3 (16.5–28.2)	1.7 (1.2–2.4)
Employment status	Working full-time[b]	652	95	14.6 (11.9–17.3)	1.0
	Working part-time	224	56	25.0 (19.3–30.7)	1.6 (1.2–2.2)
	Housewife	168	35	20.8 (14.7–27.0)	1.3 (0.9–1.9)
	Unemployed	93	17	18.3 (10.4–26.1)	1.3 (0.8–2.1)
	Ill health/disability	80	21	26.2 (16.6–35.9)	1.9 (1.2–2.9)
	Student	36	6	16.7 (4.5–28.8)	1.1 (0.5–2.4)
	Semi-retired	20	3	15.0 (3.2–37.9)	1.0 (0.3–3.1)
	Retired	428	71	16.6 (13.1–20.1)	1.1 (0.8–1.7)
Own a car	No[b]	858	153	17.8 (15.3–20.4)	1.0
	Yes	841	151	18.0 (15.4–20.5)	1.1 (0.9–1.3)
BMI (kg/m^2)	< 22.5[b]	539	94	17.4 (14.2–20.6)	1.0
	22.5–24.9	443	78	17.6 (14.1–21.2)	1.0 (0.8–1.4)
	25.0–27.4	359	59	16.4 (12.6–20.3)	1.0 (0.7–1.3)
	≥ 27.5	315	61	19.4 (15.0–23.7)	1.1 (0.8–1.5)
Smoke	Never[b]	693	116	16.7 (14.0–19.5)	1.0
	Past	496	92	18.5 (15.1–22.0)	1.2 (0.9–1.5)
	Current	514	97	18.9 (15.5–22.3)	1.2 (0.9–1.5)
Consumed alcohol	No[b]	343	64	18.7 (14.5–22.8)	1.0
	Yes	1362	241	17.7 (15.7–19.7)	1.0 (1.0–1.0)
Self-assessed health[c]	Excellent[b]	275	36	13.1 (9.1–17.1)	1.0
	Good	975	157	16.1 (13.8–18.4)	1.2 (0.9–1.7)
	Fair	377	90	23.9 (19.6–28.2)	1.8 (1.3–2.6)
	Poor	74	22	29.7 (19.3–40.1)	2.4 (1.4–3.9)
GHQ[c]	0–7[b]	390	50	12.8 (9.5–16.1)	1.0
	8–12	743	111	14.9 (12.4–17.5)	1.2 (0.8–1.6)
	13–17	286	68	23.8 (18.8–28.7)	1.8 (1.3–2.6)
	18–36	241	63	26.1 (20.6–31.7)	2.0 (1.4–2.8)
Lower back pain[c]	Absent[b]	1216	169	13.9 (12.0–15.8)	1.0
	Present	477	132	27.7 (23.7–31.7)	2.0 (1.6–2.4)
Previous neck injury[c]	No[b]	1568	268	17.1 (15.2–19.0)	1.0
	Yes	104	33	31.7 (22.8–40.7)	1.9 (1.4–2.7)

[a] Numbers do not always add to 1708 because of missing data on factors.
[b] Reference category.
[c] Indicates a significant linear trend ($P < 0.05$) between incidence of neck pain and the predictor variable after adjusting for age and gender.

ing likelihood of neck pain according to the number of children reported at baseline (test for trend adjusted for age and sex, $P = 0.004$).

There was no evidence of an association between neck pain incidence and body mass index, smoking or alcohol consumption.

3.4. Health status

Self-assessed health at baseline, in this cohort of subjects who were free of neck pain at the time of the baseline survey, was associated with an elevated subsequent incidence of neck pain. There was a clear linear trend of increasing risk across the four categories of health ($P < 0.001$), and the excess incidence among those in poor health at baseline was 16.6% above the incidence in those with self-rated excellent health at baseline.

In the univariate analysis, there was a clear trend of rising incidence of neck pain across the four categories of psychological status (GHQ score) measured at baseline (test for trend adjusted for age and sex, $P < 0.001$). The risk of subsequent neck pain among those in the highest quartile of baseline GHQ score (i.e. highest scores of psychological distress) was twice as high as that among those in the lowest quartile of GHQ score (RR 2.0 adjusted for age and sex, 95% CI: 1.4–2.8).

The presence of low back pain at baseline was associated with an increased likelihood of experiencing neck pain during the subsequent year (RR 2.0 adjusted for age and sex (95% CI: 1.6–2.4)). Crude incidence was 13.8% in excess of that in those who were free of low back pain at baseline.

Finally, although all subjects in the incidence study were free of neck pain at baseline, 104 (6.6%) recalled a past history of neck injury. Such a history was associated with an increased incidence of neck pain during the subsequent 12 months (RR 1.9, adjusted for age and sex; 95% CI: 1.4–2.7)). This was not explained by the recency of the injury. The mean number of years since the neck injury was 9.9 among those who developed pain, and 9.4 among those who did not.

3.5. Multivariate model

The figures presented so far have been adjusted to take account of any confounding effects of age or gender. However, 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 subsequent neck pain in these first analyses were next explored for their independent association with neck pain outcome at 12 months (present or absent) in a multivariate logistic regression, with age being included in this model also. Five variables were found to be independently associated with incidence of neck pain (Table 3): gender; number of children; psychological status; low back pain; previous neck injury. Both low back pain at baseline and a history of previous neck injury were independently associated with an increased risk of subsequent neck pain, after allowing for the effects of self-assessment of health and psychological status.

In order specifically to test the hypothesis that a previous neck injury is independently associated with neck pain, the separate confounding effect of each of the other risk factors was examined. The crude relative risk for previous neck injury was 1.9; the adjusted relative risks varied from 1.8 (adjusted for low back pain; psychological status) to 2.0 (adjusted for self-assessed health) and each was statistically significant. We therefore retained our multivariate predictor

Table 3
Multi-factorial model of risk factors for new episodes of neck pain based on 1708 follow-up responders free of neck pain at baseline in a Manchester adult population sample, 1992–1993

Factor	Reference category	Contrast category	RR (95% CI)
Age (years)	18–29	30–44	1.0 (0.7–1.4)
		45–59	0.9 (0.6–1.3)
		≥ 60	0.7 (0.5–1.1)
Gender[a]	Male	Female	1.2 (0.9–1.5)
Children[a]	None	One	1.2 (0.9–1.8)
		Two	1.2 (0.9–1.7)
		Three	1.5 (1.0–2.1)
		Four or more	1.6 (1.1–2.4)
Self-assessed health	Excellent	Good	1.0 (0.7–1.4)
		Fair	1.3 (0.9–1.9)
		Poor	1.3 (0.7–2.3)
GHQ[a]	0–7	8–12	1.1 (0.8–1.5)
		13–17	1.6 (1.1–2.3)
		18–36	1.5 (1.0–2.2)
Lower back pain[a]	Absent	Present	1.7 (1.3–2.1)
Previous neck injury[a]	No	Yes	1.7 (1.2–2.5)

[a] Significant linear trend of association ($P < 0.05$) between increased incidence of neck pain and the predictor variable.

Table 4
Twelve-month cumulative incidence of neck pain by baseline mailing 'wave' response in 1708 follow-up responders free of neck pain at baseline (Manchester adult population sample, 1992–1993)

	Wave[a] (%)		
	1 ($n = 1060$)	2 ($n = 477$)	3 ($n = 171$)
Crude	18.2	16.4	19.9
Standardized[b]	18.2	16.4	23.0[c]

[a] Waves 2 and 3 delayed their response until first and second reminder, respectively.
[b] Adjusted for age, gender, past history of low back pain, general health status and parity to wave 1 responders.
[c] Influenced by small cell counts in the standardisation process.

model as an appropriate estimate of the risk associated specifically with previous neck injury.

3.6. Investigation of selection bias

Non-responders to the baseline survey differed from responders in being rather more likely to be male and younger. There was no trend of difference in incidence among those who participated at follow-up according to whether they had delayed their response to the baseline or not (Table 4).

Non-participants in the follow-up survey of our study cohort differed from participants with respect to some baseline characteristics (Table 5). The effect on the cumulative 12-month incidence of neck pain was small; after standardization for age and gender to the total study cohort, estimated incidence was 17.8%, compared with a crude incidence of 17.9%; after further standardization for parity, previous history of low back pain, and self-assessment of health, the figure was 18.5%.

Finally, we adjusted the characteristics of our study population to reflect age and gender differences in responders and non-responders at baseline and then applied our observed age- and gender-stratified incidence figures. Based on this, our estimated annual cumulative population incidence of neck pain was 17.6 per 100 adults initially free of current neck pain. This is little different from the adjusted figures within the follow-up cohort. The limitation to this estimate is that it reflects age and gender differences between baseline responders and non-responders, but not unknown differences in risk factor profiles.

Table 5
Characteristics of 3034 individuals with no neck pain at baseline survey of a Manchester adult population sample in 1992: comparison of 1708 participants and 1326 non-participants at 12-month follow-up

Factor	Category	Non-participants at 12 months n (%)	Participants at 12 months n (%)	P value[a]
Age (years)	18–29	402 (30.3)	365 (21.4)	<0.001[b]
	30–44	394 (29.7)	479 (28.0)	
	45–59	236 (17.8)	316 (18.5)	
	60–75	294 (22.2)	548 (32.1)	
Gender	Male	609 (45.9)	712 (41.7)	0.001
	Female	717 (54.1)	996 (58.3)	
Marital status	Married/partner	802 (60.8)	1055 (62.0)	0.226
	Other	518 (39.2)	647 (38.0)	
Children	No	367 (27.8)	504 (29.6)	<0.001
	Yes	954 (72.2)	1198 (70.4)	
Employment status	Not working	590 (44.7)	805 (47.3)	0.978
	Working	730 (55.3)	896 (52.7)	
Own a car	No	673 (50.9)	858 (50.5)	0.754
	Yes	648 (49.1)	841 (49.5)	
BMI (kg/m^2)	<25	808 (62.3)	982 (59.3)	0.210
	≥25	489 (37.7)	674 (40.7)	
Smoke	Never	472 (35.7)	693 (40.7)	0.060
	Ever	849 (64.3)	1010 (59.3)	
Consumed alcohol	No	238 (18.0)	343 (20.1)	0.620
	Yes	1084 (82.0)	1362 (79.9)	
Self assessed health	Excellent/good	902 (68.5)	1250 (73.5)	0.014
	Fair/poor	414 (31.5)	451 (26.5)	
GHQ	<13	818 (63.6)	1133 (68.3)	0.150
	≥13	468 (36.4)	527 (31.7)	
Lower back pain	Absent	850 (64.7)	1216 (71.8)	0.001
	Present	464 (35.3)	477 (28.2)	
Previous neck injury	No	1187 (92.7)	1568 (93.8)	0.734
	Yes	94 (7.3)	104 (6.2)	

[a] P values were derived by multivariate logistic regression using all baseline factors.
[b] Test for trend.

4. Discussion

We have reported on a study which was unique in being population-based and longitudinal in design and which obtained risk factor data from a study population who were free of neck pain at the time, following them up for 1 year to identify the primary outcome (new episodes of neck pain) prospectively. We have found that the 1-year cumulative incidence of neck pain among those who were free of neck pain at baseline was 17.9%, rather higher in women than men but showing little variation with age. This is similar to the figure of 19.5% reported by Leclerc et al. for the subgroup free of baseline neck disorders in their occupation-based cohort of French adults (Leclerc et al., 1999).

We must be cautious about the exact nature of 'incidence' in our study. We defined the population at risk by 'freedom from pain in a 1-month period', but the outcome of subsequent neck pain was counted over a 12-month period. These intervals are arbitrary but attempt to reflect the recurrent, episodic, and exacerbatory nature of a problem like neck pain, in which identifying a 'first ever onset' as the marker of a true incident case is likely to be unhelpful. So our population at risk is defined by a simple window of '1 month free of neck pain', not by a criterion of lifetime freedom from the problem. This does mean, however, that new episode incidence in our study is not the same as 'first ever onset', and that the risk factors for these new or recurrent episodes may be different from those for 'first ever onset'.

The study was carried out in two practice populations in South Manchester, England, which are unlikely to be representative of the whole adult population of the UK. However, the neck pain prevalence and incidence figures compare with published population data from elsewhere (Leclerc et al., 1999). Furthermore, surveys of low back pain in this same population have produced results similar to those obtained in other UK studies (Papageorgiou et al., 1995).

Our investigations of delayed response and non-response in the baseline survey suggest that our estimates of incidence of subsequent neck pain in those initially free of pain were not biased by non-response. More importantly, with respect to the objective of our study, was the absence of a substantial effect of non-participation at 12-month follow-up on the estimates of cumulative incidence. The figure for the total cohort, accounting for differences in age, gender and prevalence of risk factors at baseline between those who did or did not participate at 12-month follow-up, was 18.5%, compared with a crude figure from participants of 17.9%. It is even less likely that the actual associations between risk factors at baseline and subsequent neck pain would be systematically different between those who did or did not participate in the 12-month follow-up.

Poor general health at baseline, psychological distress and a previous history of pain elsewhere were all found to predict new episodes of neck pain during the follow-up year. This confirms observations from earlier cross-sectional studies of neck pain (Linton, 1990; Makela et al., 1991), and from a recent prospective study in an occupation-based cohort (Leclerc et al., 1999). The linear association with number of children mirrors previous observations with respect to low back pain (Rossignol et al., 1993; Silman et al., 1995). This may be related to mechanical factors related to raising young children, since it appears to be independent of gender and psychological distress. Other mechanical factors, such as weight and height, do not appear to be important predictors of neck pain incidence.

Neck pain is common and this study gives some support to the argument that regional pain syndromes are not unique but share similar patterns of risk factors (Makela et al., 1991; Croft et al., 1995). One American study surveyed a range of regional pain complaints in a single large population and showed that the prevalence of poor health status, family status, anxiety and depression, among other characteristics, was similar in those with current pain, independent of the pain location, but clearly different from prevalence in those free of current pain (Von Korff et al., 1988).

Neck injuries are an often-stated problem in relation to chronic neck pain, particularly whiplash injuries, and we have observed an elevated risk of later neck pain in those who had a prior history of injury compared with those who did not. A previous history of injury to the neck has been reported to be a risk factor for neck pain in cross-sectional population studies (Marshall et al., 1995; Lau et al., 1996), but our study presents the first evidence that a prior history of neck injury obtained at a time when the subject is free of neck pain is a predictor of subsequent neck pain. Furthermore, this was independent of gender, general health status, psychological distress, and co-morbid pain complaints. There are several important aspects to this.

Firstly, it is important to emphasize that the results of our large population sample relate to 'injury to the neck' as recalled by a group of adults at a point in time when they stated that they were free of neck pain and with a median reported time since that injury of 9 years. It seems unlikely, therefore, that 'injury' is being equated simply with 'onset of the pain'. Reported prevalence of recalled neck injury was 11.4% of all baseline responders, and this compares in magnitude with the proportion of American adults per year who report injury-related neck pain (Hammacher and van der Werken, 1996). However, our study is limited in extrapolating to the type or nature of the injury, and injury in this study cannot be assumed to be equivalent to road traffic-related whiplash injury even though it is likely to embrace such events. Occupational trauma may be important, either as acute injury or as a perceived result of overuse; sports injury and domestic accidents are other possible causes.

Secondly, the link is not simply with chronicity, defined as a persistence of symptoms over time, since a prior history of injury at baseline predicted subsequent episodes of neck pain which would by definition have been new or recurrent. It has been suggested, in the field of low back pain, that a pattern of recurrence and intermittent pain may be a more realistic description of an individual's lifetime experience of a chronic musculoskeletal problem than a picture of relentless or continuous symptoms (Deyo, 1993). The association between future episodes of neck pain and past neck injury might similarly be better characterized as a link with recurrence, i.e. with chronicity assessed over time. This is supported by our finding that the injury had occurred on average nine years prior to the baseline survey, regardless of whether neck pain occurred subsequently during the study follow-up year or not. So the link with injury cannot be explained as a result of intermittent symptoms arising from recent trauma, and the risk would seem to be a long-term effect of injury on chronic, but episodic, pain.

Thirdly, our study minimized the possibility of recall bias, since the information in the cohort for this analysis was by definition not influenced by the current presence of neck pain. The results were adjusted in the multivariate analysis to take account of the effect of psychological status and general physical health, both of which might also have influenced recall at baseline.

Fourthly, our method of identifying recalled neck injury at baseline means that any new injury precipitating neck pain during the follow-up year would not be included. However, the median time of 9 years since injury at baseline suggests any effect of new injuries over 1 year would be minimal, and would have tended to bias our observed effect toward the null.

In population terms however only a minority of all adults (estimated at 11.4%) recall a neck injury, and so only a minority of all neck pain in the population will be associated with previous injury. This means that more generally pervasive problems in the adult population, such as psychological distress or poor physical fitness, are likely to be numerically more important influences on the total burden of adult neck pain. For those who have had a neck injury however, it would seem that the injury itself is the biggest single influence on the likelihood of developing a recurrence of neck pain.

In conclusion, most episodes of neck pain in the general population present a similar profile of risk to other regional pain syndromes, important factors being psychological distress, poor self-perceived general health and a previous history of pain. Furthermore we have confirmed a higher risk among women, previously married adults, those unable to work because of ill health, and number of children. There was no apparent link with age, weight, smoking or alcohol. However, a prior neck injury would appear to be a separate risk for long-term episodic neck pain, independent of recall bias and not explained by psychosocial influences on the development of chronic pain. The suggestion is that a history of neck injury is a distinct and separate risk factor from the other major predictors of chronic pain, at least for episodic recurrence. This might explain the similarity in the prevalence of neck pain observed in population studies and in neck injury cohorts (i.e. they are dominated by different subgroups but the overall risk of persistent neck pain is similar in degree). This would be consistent with studies that have identified persistent pain that is responsive to local anaesthesia in chronic whiplash patients (Lord et al., 1996).

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