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Journal of Adolescent Health 46 (2010) 488–494

JOURNAL OF ADOLESCENT HEALTH

Original article

A Prospective Study of Neck, Shoulder, and Upper Back Pain Among Technical School Students Entering Working Life

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Manuscript received August 26, 2009; manuscript accepted November 11, 2009

Abstract

Purpose: The aim of this prospective study was to relate the prevalence of neck, shoulder, and upper back pain to occupational and individual risk factors among a population of technical school students in their transition from school to working life. In addition, we wanted to assess the changes in pain prevalence during follow-up.

Methods: A cohort consisting of 173 technical school students was followed up during a 3-year period, from their last year of school through their first years of working life. Data on self-reported neck, shoulder, and upper back pain and factors such as mechanical exposure, perceived stress, and physical activity in leisure time were collected.

Results: A high prevalence of pain in the neck, shoulder, and upper back among the technical school students was found. There were however few students reporting severe pain. Reporting pain at baseline gave over three times higher risk of reporting it at follow-up. A high level of physical activity outside working hours gave a lower risk of reporting neck, shoulder, and upper back pain at follow-up. High and moderate levels of mechanical exposure and high stress level were not found to be risk factors for pain after entering working life.

Conclusion: Neck, shoulder, and upper back pain are common among adolescents and may persist into working life. These results may give potential for preventive efforts at a young age. There is still much uncertainty about the factors leading to musculoskeletal pain, and more research is needed on this topic.

Keywords: Musculoskeletal pain; Technical school students; Occupational factors; Individual factors

Musculoskeletal pain has been reported as a problem among adolescents [1]. Previous cross-sectional data from our study showed a high prevalence of pain among technical school students, especially among females [2]. In a Finnish cohort of high school students 17% reported disturbing symptoms in the neck and shoulder [3]. Musculoskeletal symptoms are also a common problem in the working population [4], and in European countries between 30% and 40% of all musculoskeletal symptoms are believed to be work-related [5]. The findings of high pain intensity levels in an early age have led to suggestions that the basis for work-related musculoskeletal pain may be formed during adolescence [6–8]. It may therefore be important to identify possible risk factors among adolescents and young workers in order to prevent the development of musculoskeletal pain later in life. It is assumed that the causes of musculoskeletal complaints are multifactorial [9,10], implying that several different risk factors contribute to its development. Occupational factors such as prolonged static muscle load and repetitive work [11–13] may be a source for pain development. Gender and physical activity are also factors that may be associated with musculoskeletal pain. Longitudinal studies concerning musculoskeletal symptoms among adolescents are sparse, and we lack knowledge on what extent pain in adolescence may predict pain experienced after entering working life. The data in this study are longitudinal, following self-reported musculoskeletal pain in a cohort of

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1054-139X/10/$ – see front matter
doi:10.1016/j.jadohealth.2009.11.200

technical school students from school and through their first years of working life.

The main aim of this prospective study was to relate the prevalence of neck, shoulder, and upper back pain to occupational and individual risk factors among a population of technical school students in their transition from school to working life. Second, we wanted to assess the changes in pain prevalence during follow-up.

Methods

The study population consisted of 420 technical school students from 13 schools in the greater Oslo area (85% of the 496 who were invited). Technical school students are defined as students enrolled in a public college that provides mostly employment preparation skills for trained labor. The students choose a specific occupational program and they are taught the skills needed to perform a particular job. The technical school students in this study were recruited to represent student hairdressers, student electricians, and art/media/design students. Data in the project are collected every 3 months during a six-year period. The present study use data collected on three occasions; baseline (October 2002), 1-year follow-up (October 2003), and 3-year follow-up (December 2005). Of the 420 participants, 173 answered all three questionnaires. The sample consisted of 59 male and 114 female students. In both genders the median age was 17 years in 2002. At baseline all the students had just started their second year of technical school and had 1 year before most of them started their apprenticeship in their respective fields. They were further followed up through their first years of apprenticeship period and working life. Table 1 shows further baseline characteristics of the study sample. No differences in neck, shoulder, and upper back were found between the study group and the group lost to follow-up, neither for men nor women.

In all three questionnaires the participants were asked to recall if they had experienced neck, shoulder, and upper back pain during the last 4 weeks. An illustration was used to ensure a common understanding of the body parts [14]. Modified questions from Statistics Norway were used [15], and they were asked for both the pain intensity (not troubled, little troubled, quite troubled, very troubled) and the pain duration (1–5 days, 6–10 days, 11–14 days, 15–28 days). A pain index (0–12) was calculated by multiplying the pain intensity (0–3) and duration (1–4). The reliability of this method has been found acceptable [16]. On the basis of the pain index the data were dichotomized into a no pain group and a pain group. Cut off was set between 0 and 1, meaning that those with pain had reported at least little trouble for 1–5 days in the last 4 weeks. Self-reported work-related mechanical exposure was assessed by a 12-item index (MI2) [17], collected with a questionnaire on the same time as the outcome measurement; baseline, 1-year and 3-year follow-up. The participants were asked whether their work involved or required repetitive movements (one item), precision movements (one item), manual material handling (two items), vibration (one item), and body postures (seven items) such as working with their arms elevated, their neck bent backward, and their back twisted or bent forward. A total of 12 questions with three response alternatives (hardly nothing/not at all, somewhat, a great deal) gave an index in the range 0–24. The validity and reliability (test–retest stability) have been tested for the index and were acceptable [17]. The index score was categorized into three levels of mechanical exposure; 0–6 (low level), 7–11 (moderate level), and 12–24 (high level).

The participants were in a single question asked about their perceived stress level at school/work [18]. The response of this variable was dichotomized into low stress level (never or sometimes) and high stress level (often or very often). One question was used to collect information on their frequency of physical activity during leisure time. The participants were asked how often they performed activities that led to increased heart rate or shortness of breath. The question had seven response alternatives ranging from 0 (never) to 6 (everyday). The variable was dichotomized in two groups: active once a week or less (low level) and two-three times a week or more (high level) [18]. Socioeconomical background was assessed by one question at baseline. They were asked how well-off their family was. Five response alternatives were given, ranging from 1 (very well-off) to 5 (not well off at all). The students were categorized in a medium/high (1–3) and a low (4–5) socioeconomical background. The participants were also asked whether they worked in addition to their full-time work/study (additional part-time work).

The regional Committee for medical Research Ethics and The Norwegian Data Inspectorate approved the study. Written consent was obtained from the students at the baseline assessment, in addition to a written parental consent for students younger than 18 years.

SPSS (version 15.0) was used for analyzing the data. Univariate analyses were carried out, using logistic regression and calculating odds ratios with 95% confidence interval (CI). Mann–Whitney U tests were used on continuous data and chi-square statistics on categorical data, to compare the population and those lost to follow-up. To explore possible gender differences the chi-square tests were used. Wilcoxon signed rank test was used on the continuous data to evaluate possible changes in scores from the 1-year follow-up to the 3-year follow-up. Finally, multivariate analyses were done using logistic regression to assess for potential risk factors using odds ratios.

Results

Factors related to neck, shoulder, and upper back pain

A high initial prevalence of neck, shoulder, and upper back pain was seen; 78% female and 47.5% male students reported at baseline that they had pain the past 4 weeks.

Table 1
Baseline characteristics of the technical school students

Variables	Study group, n = 173		Lost to follow up, n = 247	
	Men (n = 59)	Women (n = 114)	Men (n = 94)	Women (n = 153)
Age % (n)				
16–18 years	91 (54)	91 (104)	85 (80)	87 (133)
19–21 years	9 (5)	8 (9)	15 (14)	10 (16)
≥22 years	0 (0)	1 (1)	0 (0)	3 (4)
Study course % (n)				
Electrician	78 (46)	4 (4)	71 (67)	1 (1)
Hairdresser	2 (1)	48 (55)*	3 (3)	70 (108)*
Art/media/design	20 (12)	48 (55)	26 (24)	29 (44)
BMI % (n)				
<18.5	17 (9)	10 (10)	11 (9)	14 (17)
18.5–24.9	66 (34)	71 (75)	63 (52)	71 (90)
≥25	17 (9)	19 (20)	26 (22)	15 (19)
Smoking % (n)				
Yes	20 (12)*	50 (57)	48 (45)*	43 (87)
No	80 (47)	50 (57)	52 (49)	57 (65)
Socioeconomical background % (n)				
Low	17 (10)	12 (14)	16 (15)	17 (26)
Medium/high	83 (49)	88 (99)	84 (79)	83 (124)
Parental origin % (n)				
Western countries	90 (52)	82 (93)	88 (82)	85 (130)
Non-western countries	10 (6)	18 (20)	12 (11)	15 (22)
Pain at baseline % (n)				
No pain	52.5 (31)	22 (25)	45 (42)	17 (25)*
Pain	47.5 (28)	78 (78)	55 (52)	83 (121)

The BMI variable had 7 missing for men and 9 for women in the study group.
The socioeconomical variable had 1 missing for women in the study group.
The parental origin variable had 1 missing for both men and women in the study group.
The pain at baseline variable had 7 missing for women in the lost to follow-up group.
* $p < .05$, significant difference between study group and the group lost to follow-up, within gender.

Neck, shoulder and upper back pain decreases at the 1- and 3-year follow-up (Figure 1), but the significant gender difference remains.

Because of the significant gender difference in pain reports the univariate analysis was done separately for male and female students. The unadjusted logistic regression in Table 2, shows that reporting pain in the neck, shoulder, and upper back at baseline gave an increased risk of reporting pain 3 years later for males (odds ratio [OR] = 3.6, 95% CI: 1.13–11.52) and females (OR = 2.9, 95% CI: 1.18–7.35). The subjects who reported pain at 1-year follow-up were also at risk of reporting pain at 3-year follow-up (OR = 3.6, 95% CI: 1.90–6.67) (not shown in the table). The male students that had additional part-time work at 1-year follow-up had four times higher risk of reporting pain at the 3-year follow-up. High and moderate mechanical exposure did not give an increased risk of pain in the neck, shoulder, and upper back at follow-up. The 12 single items in the mechanical exposure index showed individually no associations with pain at follow-up (not shown in the table).

The adjusted odds ratio for neck, shoulder, and upper back pain at 3-year follow-up showed that reporting neck, shoulder, and upper back pain at baseline gave over three times higher risk of reporting it at the 3-year follow-up (Table 3). The subjects reporting that they were physically active two to three times per week or more had a significantly lower risk of reporting pain 2 years later compared to those reporting a lower physical activity level. High level of mechanical exposure gave no increased risk; in fact, they showed a tendency that high exposure had a preventive effect on neck, shoulder, and upper back pain 2 years later. The odds ratio was adjusted for stress level, additional part-time work, and gender. When substituting the baseline pain with pain reported at 1-year follow-up, there was no difference in the results (not shown in table).

A multivariate analysis was also done for female and male participants separately, giving a lower precision of the estimate but confirming the findings that reporting neck, shoulder, and upper back pain at baseline gave a higher risk of reporting the same at the 3-year follow-up (males: OR = 9.2, 95% CI: 1.79–47.60 and females: OR = 2.8, 95% CI: 1.07–7.54).

Changes in prevalence of neck, shoulder, and upper back pain

Figure 2 illustrates the movement of participants from the ‘‘no pain’’ group to the ‘‘pain’’ group over the 3-year period. Of the participants, 18% (37% male and 9% female participants) reported no pain at the three occasions, while 28%

Table 2
Unadjusted odds ratio for pain in the neck, shoulder, and upper back at 3-year follow-up

Variables	Level	Men (N = 59)		Women (N = 114)	
		Unadjusted odds ratio	95% CI	Unadjusted odds ratio	95% CI
Pain at baseline[a]	No pain	1.00		1.00	
	Pain	3.61	1.13–11.52	2.95	1.18–7.35
Mechanical exposure[b]	Low	1.00		1.00	
	Moderate	.95	.20–4.54	1.55	.60–3.90
	High	.35	.09–1.30	.88	.33–2.36
Stress level[b]	Low	1.00		1.00	
	High	.97	.25–3.74	1.20	.54–2.65
Smoking[a]	No	1.00		1.00	
	Yes	1.07	.28–4.11	1.45	.68–3.07
Physical activity[b]	Low	1.00		1.00	
	High	.56	.18–1.70	.65	.30–1.39
Additional part-time work[b,c]	No	1.00		1.00	
	Yes	4.24	1.26–14.30	.99	.47–2.10

Questions are adjusted to a school situation at baseline.
[a] Data were taken from the baseline questionnaire.
[b] Data were taken from the 1-year follow-up.
[c] Additional part-time work is defined as work in addition to fulltime work/study.

of the participants reported pain at all three occasions (14% male and 35% female participants).

When examining the participants reporting pain in all questionnaires (‘‘continuous pain’’), results show a tendency that increasing mechanical exposure was related to higher risk of having ‘‘continuous pain.’’ The odds ratio was 2.00 (95% CI: .43–9.15) for moderate exposure and 2.40 (95% CI: .47–12.24) for high mechanical exposure. This analysis was adjusted for perceived stress, gender, physical activity, additional part-time work, and smoking. The adjusted odds ratio for the ‘‘continuous pain’’ group was higher for females compared to males (OR = 9.65, 95% CI: 2.5–37.26), and for reporting high compared to low stress levels (OR = 6.12, 95% CI: 1.22–30.72).

To discriminate participants reporting a more severe pain compared to those with no/little pain, the pain cut off was set between 2 and 3. To end up in the severe pain group, the participants had to be at least very troubled for 1–5 days or little troubled for 11–14 days in the last 4 weeks. Of the participants, 26% reported severe pain at baseline, decreasing to 18% and 13% after 1- and 3-year follow-up, respectively, when using this higher cut off level. More females than males reported severe pain. Severe pain at baseline was reported in 14% of the male and 32% of the female participants. At the 3-year follow-up, only 7% of the male and 18% of the female participants reported severe pain.

Discussion

The results show that a considerably higher number of female compared with male adolescents report neck, shoulder, and upper back pain. At the same time, males tend to report higher levels of mechanical exposure than females. These gender differences are significant at baseline

Table 3
Adjusted odds ratio for some pain in the neck, shoulder, and upper back at 3-year follow-up

Variables	Level	Adjusted odds ratio	95% CI	*p*
Pain at baseline[a]	No pain	1.00		
	Pain	3.65	1.67–7.98	<.01
Mechanical exposure[b]	Low	1.00		
	Moderate	1.34	.57–3.16	.50
	High	.44	.18–1.05	.07
Stress level[b]	Low	1.00		
	High	.66	.31–1.43	.30
Physical activity[b]	Low	1.00		
	High	.42	.20–.87	.02
Additional part-time work[b,c]	No	1.00		
	Yes	1.40	.68–2.90	.36
Gender	Male	1.00		
	Female	1.35	.60–3.03	.46

[a] Data were taken from the baseline questionnaire.
[b] Data were taken from the 1-year follow-up.
[c] Additional part-time work is defined as work in addition to fulltime work/study.

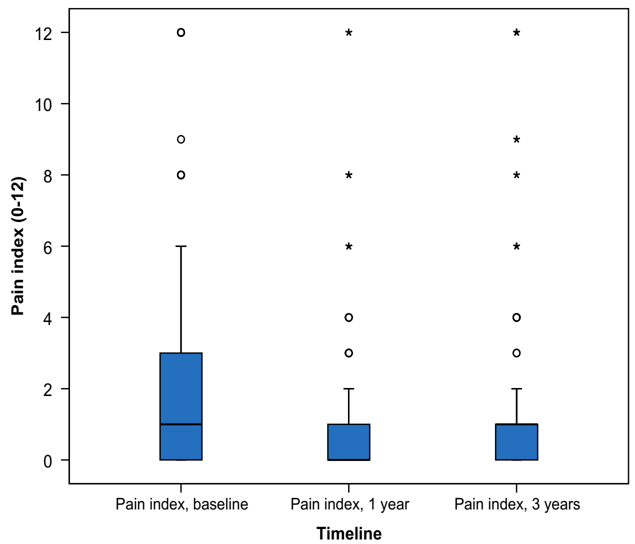

Figure 1. Pain reported in the 3-year period. (0 indicates outliers that extend more than 1.5 box-lengths from the edge of the box, * indicates extreme points that extend more than 3 box-lengths from the edge of the box).

and in both follow-up questionnaires. Several studies have revealed that females report significantly more pain than males, both in the young [6,19] and adult populations [20,21]. It has been shown in a previous study that the reporting of health complaints is influenced by social and individual expectations [22]. There might also be differences in the understanding of ''pain.'' Females are maybe more sensitive to their bodily responses and consider it more acceptable to report complaints [23]. This might to some extent explain the gender differences. Some literature has also suggested that this difference may result from having different types of jobs. In our study the female and male participants have quite different types of work and they experience different types of mechanical exposure. Most of the females are hairdressers or students and most of the male participants are electricians, and this may explain some of the gender difference in pain reports. Even so, the gender difference was seen in the cohort even before they started their working career. It has been suggested that the gender difference emerges during adolescence and persists into adulthood [23], and this is supported by our findings. Our results show that participants who reported neck, shoulder, and upper back pain at school had over three times higher risk of reporting pain at the 3-year follow-up. Some literature has pointed out a history of pain as the most important predictor for future pain; this has especially been a focus in research on low back pain [24,25]. There is however a lack of studies concerning neck and upper extremity pain among young adults and their development after entering working life. The knowledge that earlier pain predicts future pain may reflect earlier exposure to risk factors, individual genetics, social susceptibility, or generally a higher tendency to report pain among some people. Our results suggest that the foundation for occupational pain to some extent may be created already in youth. This assumption is in accordance with previous studies [6,8].

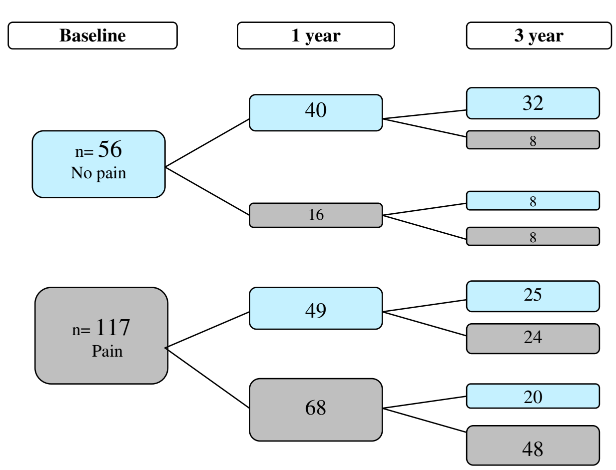

Figure 2. Flow diagram showing the change in neck, shoulder, and upper back pain reports during the 3-year period (N = 173).

Our results indicate that reporting pain is quite common among technical school students. It maybe regarded as part of daily life and that low levels of pain do not influence, for example, work ability. Pain reports in childhood and early adolescence seem to be associated with the report of pain in early adulthood, and our study illustrates that the technical school students with pain at baseline have increased risk of pain 3 years later. This may in fact illustrate that low levels of pain may be a lifelong phenomenon.

A higher prevalence of neck, shoulder, and upper back pain at baseline was found, compared to the two follow-ups. The same is shown in an older working population [16]. Several factors may influence the initial high response. Questions about musculoskeletal pain may have increased the participants' awareness of minor pain or complaints. It can also be that the pain measurement we used captured information on something other than bodily pain. It has been suggested to omit the initial report and use the subsequent report to produce adequate representation of the complaint severity. Replacing the baseline report with the 3-month follow-up in our study did not change the results of the multivariate analyses.

Several previous reviews that conclude that mechanical exposures such as heavy physical load, repetitive movements, and awkward postures have an impact on shoulder and neck pain is not in agreement with our results [11–13,26,27]. It is important to take into account that these previous studies concerning neck/shoulder pain and mechanical exposure mainly focused on older subjects who had a longer exposure time. Therefore, the results are possibly not comparable with the findings in our study. It may be argued that to be able to find an effect of mechanical work exposure a longer exposure time after the participants enter working life is necessary. Mechanical factors such as trunk flexion and rotation have however been found as risk factors for back pain in a cross-sectional study among young workers in their first employment [28]. The self-reported index MI2 used in this study has earlier been tested on longitudinal data showing that 11 of the 12 items included were significantly related to the 1-year incidence of shoulder–neck pain among an older working population [17]. We found no predictive value of the instrument MI2 assessing mechanical exposure, which may indicate that the self-reported mechanical exposure is not a factor of great importance when explaining pain in technical school students entering working life. The MI2 index is a medium force index that mainly comprises poor postures and does not focus on repetitiveness, lifting, and the inactivity of the work task. This may have contributed to the lack of predicting value of the mechanical exposure variable in this study.

Inconsistent evidence related to an effect of physical activity on neck pain has been reported in previous literature [29,30]. Our study found an association between a low level of physical activity and the reported neck, shoulder, and upper back pain. A positive effect of physical activity has also been found previously, among 15-year-old students [31]. A previous study has also stated that a low level of physical activity may be one of the main causes behind the development of musculoskeletal pain [8]. In addition a prospective study of a general population showed that performance in certain fitness tests at the age of 16 and at follow-up at age 34, was negatively associated with musculoskeletal symptoms in adulthood, implying benefits of early fitness training [32]. Other studies however failed to find such an association [30,33]. In an earlier review no association was found between the subjects participating in physical activity in leisure time and musculoskeletal symptoms such as neck pain [29].

One of the strengths in this study is the fact that the participants were in school when included, meaning that they were practically not exposed to work-related risk factors. The cohort was then followed up when they started their working career. One of the possible limitations of the study is the use of self-reported measures of all variables. A self-administrated retrospective questionnaire has the limitation of participants failing to remember previous symptoms. Miranda et al found that recall 6 years later was strongly influenced by their current symptoms [34]. Another study found that participants are capable of retrospectively remembering the severity of their pain in a 3-month period [35]. In our study we asked subjects for their experienced pain the last 4-weeks, giving a shorter recall period and hopefully reducing the possible recall bias. Another limitation of the study is the high number of loss to follow-up, which resulted in a small study population giving a lower precision in the estimates. Our results may also have been biased by selection, meaning that the students who were experiencing high pain levels were lost to follow-up (healthy worker effect). Analyses show however that there was no significant difference in our baseline data, with regard to pain among the study group and the group lost to follow-up. It is however also a possibility that the participants who developed pain during follow-up were more likely to stay in the study, which would affect the odds ratio for pain in our results.

In conclusion, our results show that self-reported mechanical exposure is not a risk factor for neck, shoulder, and upper back pain among technical school students after they enter their first years of working life. A high level of physical activity outside working hours is however found associated with lower risk of reporting neck, shoulder, and upper back pain. Our results highlight an association between neck, shoulder, and upper back pain reported at baseline and pain reported 3 years later when most of the participants had entered working life. This illustrates the possibility that experienced pain emerging in late adolescence can persist into working life. There is still much uncertainty about the factors leading to the development of musculoskeletal pain.

Acknowledgments

This study was supported by a grant from the NHO, Confederation of Norwegian Enterprises. We also thank Nina Østerås and Kristian Gould for helping with data collection at baseline and 1-year follow-up.

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