INTERRELATIONSHIP BETWEEN INCIDENT EYE-AND NECK/SCAPULAR AREA SYMPTOMS

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An augmented activity level in eye-muscles may cause a parallel increase in neck/scapular area load. The current objective was to test this interrelationship in a prospective cohort design which focused on symptom association. A case in the specific body region was defined as a subject who was classified as symptom free in that region at baseline or during minimum of one follow-up period and later reported symptoms ≥ 3 days. To analyze the interrelationship between eye-neck/scapular area symptoms and vice versa the presence of symptoms was based on cumulated reported symptom years divided by person years follow up time. Times to case for exposed and not exposed computer workers were described and analyzed by incidence ratios and Kaplan-Meyer survival curves. Potential confounders were controlled for in a concluding multivariate analysis. The groups with strong symptoms (≥ 5 %) had a significantly higher incidence rate when compared with the group with mild symptoms (< 5 %) (Log rank test p < 0.0001 for neck/scapular with eye symptom and p< 0,0001 for eye with neck/scapular symptom). In the multivariable analyses eye symptoms were still related to the incidence of symptoms in the neck/scapular area and vice versa.

Keywords: computer work, gaze-control, visual symptoms, neck/scapular area symptoms

1 Introduction

According to our research model, an increase in visual loads (augmented activity levels of eye-muscles) over time, due to deficient optical/ physiological aspects of the near work (e.g., incorrect optical correction, uncorrected visual correction, deficient work station layout, insufficient rest periods, etc.), causes not only eye symptoms, but also give rise to a parallel increase in musculoskeletal load and symptoms in the neck/scapular area (review: Richter and Forsman, 2011). See Fig. 1. These complaints may either be physiologically interrelated (Richter & Knez, 2007; Rosenfield, 2011), or alternatively, be a result of a change in posture e.g. triggered by eye-fatigue (Mon-Williams et al., 1999) or non-optimal spectacle correction (Horgen, et al., 2004). Alternatively, oculomotor fatigue may lead to a secondary change in innervations to the postural muscles in the neck scapular area, resulting in less movement variability (Mathiassen, 2006) and/or more muscle load and discomfort in these areas (Richter et al., 2005; 2011). It-workers with eye symptoms have been shown to have an elevated (crossectional) risk of having neck/scapular area symptoms (Wiholm, 2007; Richter et al., 2011). To our knowledge, the present study is the first that has analyzed developing interrelationships between eye-neck/scapular area symptoms in a prospective cohort study while controlling for several potential confounders.

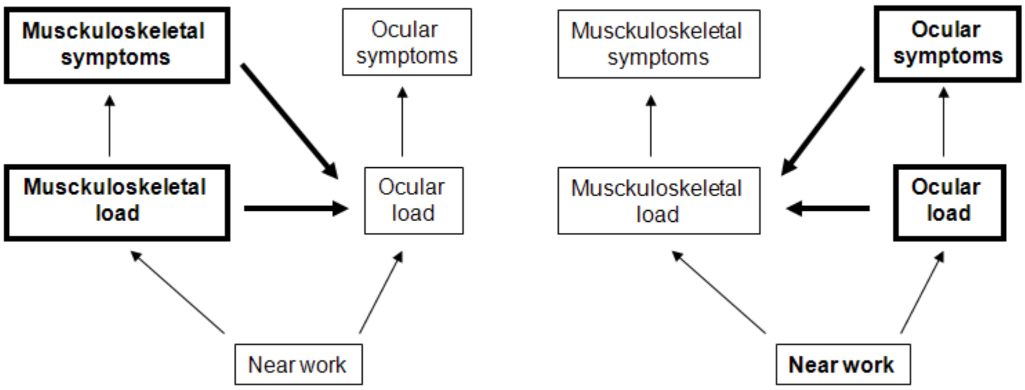

Figure 1. Eye - neck/scapular area interactions during strenuous near work
(*Left panel)*. **Postural change mechanisms.**
Individuals with musculoskeletal symptoms may be forced to compromise the optimal gaze angle and thereby creating oculomotor load and produce symptoms of visual discomfort.
(*Right panel*). **Gaze control.**
Models for gaze control, originating from neurophysiology, functionally links the oculomotor system with the neck and scapular area muscles. “Visual effort” in response to near work fatigue caused by deficient visual ergonomics (e.g., erroneously placed visual display or to small font size) or uncorrected visual error (e.g. latent over sightedness or squint), may increase musculoskeletal load via a shared motor program responsible for posturing gaze. When triggered by work strain, a common motor program may drive and posture the visual-musculoskeletal effectors in one synergistic fashion. Ocular accommodation/vergence may, alternatively, inhibit the dynamic eye-head-body scanning program, leading to a mainly “static” posture and load for the eyes and neck-scapular area muscles. The end result in either case could be work related myalgia due to sustained loading of the neck and shoulders.

1.1 Aim
The aim of the present study was to test the model and the aforementioned hypothesized cause-and-effect relationship (cf. Fig. 1) in a prospective cohort design. In the statistical analysis the effect of eye symptoms on neck/scapular area symptoms were elucidated after controlling for a number of potential confounders/individual variables which by themselves may cause a visual-or-neck/scapular area symptom which is unrelated to the other symptom from the other body region.

1.2 Findings to be presented
The present analyses show that the incidence of neck/scapular area symptoms among professional computer users is high and related to the presence of eye-symptoms. The effect of neck/scapular area symptoms as a trigger for eye-symptoms was also apparent, although to a less pronounced degree. The results from the present study, which will be presented in more detail, give for the first time direct support for the notion that some eye-symptoms are causally related to neck/scapular area symptoms.

2 Methods

2.1 Subjects

This study is a part of a comprehensive prospective follow-up study of factors associated with incidence of disorders among professional computer users in Sweden at the end of the 1990-ies. Overall descriptions of the study have been reported elsewhere (Karlqvist et al., 2002; Tornqvist, et al., 2009). 1531 computer users of different professions (medical secretaries, receptionists, administrators, civil engineers, graphical editors, call centre operators etc) at 46 companies were enrolled, whereof 1283 answered the baseline questionnaire (498 men and 785 women) constituting the study population, whereof 1246 participated in at least one follow-up (97%). The working environments and equipments varied but were generally of good design and quality. The majority used CRT displays.

2.2 Derivation of index control variables

The baseline questionnaire asked about symptoms and working conditions and individual factors. Age (3 levels: <= 36 yrs; 36 – 50 yrs. Or; >=50 yrs.), gender (female/male), body height and weight calculated as BMI (two levels: high/low), nicotine use (yes/no) and educational level (three levels: low: primary, O-level, technical college; medium: Secondary A-level; and high: Post secondary) were asked about. Mental demands and authority over decisions according to the Demand-Control model were rated on scales with 4 categories (Yes, often up to No, almost never). Two indices were calculated: Demands (3 items) and Control (3 items) (Theorell et al., 1988). Subjects were also asked about how many percent of these were spent doing computer work as opposed to doing other work related activities (e.g. typing, telephoning, non-computer desk-work, reast-break, etc) (recalculated to hours/ day – Computer Time; 3 levels (low; ≤2 hours/day; medium: 2- 4 hours/day; and high < 4 hours/day).

2.3 Derivation of indices for visual and musculoskeletal symptoms variables

Subjects were asked to register eyes, neck, right/left scapula symptoms estimating the number of days during the preceding month with each specific symptom. During the follow up period 10 roughly monthly questionnaires asked about symptoms during the past month in a similar way as at baseline. Subjects reporting symptoms from the eyes during 0, 1 or 2 days were considered as “symptom free” from the eyes, and those reporting symptoms ≥3 days from the eyes were considered as having eye-symptoms. Subjects, who were symptom-free at baseline (or later if they had symptoms at baseline but recovered during the follow-up period and were symptom free during minimum one month) and reported symptoms in a later follow-up questionnaire, were considered as incident cases of eye-symptoms. The presence of symptoms at baseline as a risk factor for the reoccurrences of similar symptoms was also computed.

2.4 Case definitions and indicies of strong and mild symptoms

A case in the specific body region was defined as a subject who was classified as symptom free in that region at baseline or during minimum of one follow-up period and later reported symptoms ≥ 3 days. To analyze the interrelationship between eye-neck/scapular area symptoms and vice versa (i.e., to indirectly probe the interrelationship between augmented muscle loads) the presence of symptoms was based on cumulated reported symptom years divided by person years follow up time. The quotient was dichotomized into strong symptoms (>5%) and mild symptoms (≤ 5 %). Times to case for exposed and not exposed computer workers were described and analyzed by incidence ratios and Kaplan-Meyer survival curves. Potential confounders were controlled for in a concluding multivariate analysis.

3 Results

3.1 Incidence ratios

The overall incidence rate for neck/scapular area symptoms was 0,67 cases per person year with an average eye symptom prevalence of 1,8 % of the follow up time. The overall incidence rate for eye symptoms was 0,31 cases per person year with an average neck/scapular area symptom presence of 5,1%.
The specific incidence ratios for those with and without concurrent symptoms in the other body region will be presented.

3.1.1 Kaplan-Meyer survival curves:

The groups with strong symptoms (>5 %) had a significantly higher incidence rate when compared with the group with mild symptoms (≤ 5 %) (Log rank test $p < 0,0001$ for neck/scapular with eye symptom and $p< 0,0001$ for eye with neck/scapular symptom). Kaplan-Meyer survival curves showing the difference in symptoms during follow-up between workers with and without concurrent symptoms in the other body region will be presented.

3.2 Multivariable analyses

In the multivariable analyses eye symptoms were still related to the incidence of symptoms in the neck/scapular area and vice versa. Risk factors and protective factors associated with eye-neck/scapular area symptoms will be presented for the different explanatory variables included in the present analysis.

4 Discussion

The aim of the present study was to elucidate the joint occurrence of eye-neck/scapular area symptoms while controlling for the potential influence from individual risk factors as well as work-related exposure factors among professional computer users. The present findings, to be presented in more detail, replicate and extend previous cross-sectional results (cf. Wiholm et al., 2007; Richter et al., 2011).

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