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Pain Catastrophizing and Lower Physical Fitness in a Sample of Computer Screen Workers with Early Non-specific Upper Limb Disorders: A Case-control Study

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Abstract: In computer workers psychological factors and physical fitness may play an important role in the onset and course of non-specific work-related upper limb disorders (WRULD) beyond socio-demographic factors. Based on our experiences in daily practice we assumed that pain catastrophizing and other psychological variables such as perfectionism, anxiety state and trait, and low physical fitness, are possibly associated with the occurrence of WRULD. We aim to study the association between pain catastrophizing, perfectionism, anxiety (state and trait), physical fitness, sex and level of education and the occurrence of WRULD, controlling for age as a confounder. Eighty-eight computer workers with early non-specific WRULD, who had been recruited for an intervention study, were compared with 31 healthy computer workers (controls) recruited from different departments of a university. This cross-sectional case-control study examined the influence of aforementioned variables on WRULD by means of logistic regression analyses. Among the different predictor variables investigated, pain catastrophizing (OR=1.37; 95%CI 1.17–1.59) and lower physical fitness had a positive relationship with WRULD (OR=0.65; 95%CI 0.48–0.87). According to this study, pain catastrophizing and lower physical fitness seem to be associated with early non-specific WRULD in computer workers. Prospective studies are needed to unravel these relationships.

Key words: Case-control study, Non-specific work-related upper limb disorders, Pain catastrophizing, Physical fitness, Computer workers

Introduction

Previous studies have shown that non-specific work-related upper limb disorders (WRULD) among computer screen workers develop as a result of extended screen work[1–3]. However, contrary to this, a recent longitudinal cohort study among office workers in the Netherlands showed that long duration of computer work did not predict the occurrence of upper limb disorders[4]. In general, previous research on existing associations between physical[4, 5], psychosocial[4, 6–8] and psychological[4, 7, 9] risk factors, and the development of upper limb disorders showed mixed results. Psychosocial factors, especially moderate to low reward and low task variation, appeared to have an association

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with the onset of upper limb disorders[4, 7]. A large cross-sectional study among bank employees showed that job stress was strongly associated with the development of upper limb disorders[8]. With respect to psychological risk factors, especially overcommitment[4, 7], psycho neuroticism and neurotic perfectionism[9] showed a relationship with the onset of upper limb disorders. In a study among PhD students with upper limb disorders it had been shown that a high score on the Trait Anxiety Inventory (STAI 2) was associated with sooner absenteeism from work and self-perceived disability[10]. Demographic data further indicate that persons suffering from non-specific WRULD are often highly educated, have long working days, and are over 30 yr of age with an over-representation of women[4, 11, 12]. It appears that beyond socio-demographic factors, primarily psychosocial and psychological factors play a role in the onset and course of upper limb disorders.

We conducted a randomized trial among computer screen workers with early non-specific upper limb disorders in which one group received postural exercise therapy and the other group regular physiotherapy. We showed that at one year follow-up still 45% suffered from upper limb complaints[12]. A remarkable finding in this study was the high score at baseline on the Pain Catastrophizing Scale (PCS) for both groups[12]. Since physically oriented interventions, also in early stages of non-specific upper limb disorders[12], are not able to eliminate upper limb disorders, further research needs to focus on psychosocial and psychological factors. With regards to low back pain, Sullivan previously demonstrated the relation between pain catastrophizing and chronic pain, while Vlaeyen explains why pain becomes chronic during the process of catastrophizing[13, 14].

In order to gain more insight into the relationships between psychological-, physical-, demographic characteristics and beginning upper limb disorders, we conducted a case-control study among computer screen workers by means of comparing the baseline characteristics of the participants in our previously conducted randomized controlled trial with the baseline characteristics of a control group of non-cases.

The main research question in the present study is therefore: are computer screen workers with early non-specific work-related upper limb disorders (WRULD) more susceptible to catastrophizing behavior, more anxious and neurotic perfectionists and less physically fit compared to non-cases?

Subjects and Methods

The baseline characteristics of 88 employed computer screen workers with early non-specific upper limb disorders who participated in a randomized controlled trial[12] (cases) were compared with the characteristics of a control group of 31 employed computer screen workers (controls).

As a result, the inclusion criteria for participants in this randomized controlled trial and for being a case in this case-control study were: being a computer screen worker employed for more than 3 months and working at least 4 h per day and 20 h per week, between 20 and 45 yr of age and experiencing early non-specific upper limb disorders with a duration of symptoms between 2 wk and 3 months[12]. Early non-specific work-related upper limb disorders (WRULD) were defined as: pains and tingles in upper back, neck, shoulders, arms or hands related and restricted to computer screen-work, not yet present during other daily activities and not labelled as a specific diagnosis such as tennis elbow or carpal tunnel syndrome. The inclusion of the cases took place between May 2003 and February 2005. They were recruited by means of advertisements in local newspapers, through personal contact with occupational physicians of large companies, and by mailing to general practitioners[12]. The control group consisted of computer screen workers who did not have any past or present upper limb disorders. They were recruited among employees of several departments, staff and PhD students of Maastricht University between November 2007 and June 2008. In order to be included they had to perform computer work for at least 4 h per day and 20 h per week for at least 3 months to make them comparable to the cases. Recruitment took place by advertisements at the different departments. Potential participants for the control group were recruited and finally selected by the same occupational physician (AvA) who performed the selection of the participants of the randomized controlled trial in 2003, 2004 and 2005.

All participants of the present study completed a baseline questionnaire that consisted of a general section on socio-demographic characteristics and specific questionnaires on psychological and physical risk factors. The time taken to fill out the questionnaire was approximately twenty minutes. Socio-demographic characteristics comprised sex, age and level of education. Participants were labeled as "highly educated" if they had at least a bachelor's degree.

Psychological and physical risk factors

Additionally to the aforementioned socio-demographic factors, validated specific questionnaires were used to assess psychological and physical risk factors. These potential psychological risk factors were: pain catastrophizing as assessed with the Pain Catastrophizing Scale (PCS, range 0–52 points)[15]; anxiety as assessed with

the State (1) respectively Trait (2) Anxiety Inventory (STAI 1 & 2, range 20–80 points of both subscales)[16] and (neurotic) perfectionism as assessed with the slightly adjusted Multidimensional Perfectionism Scale, (MPS, range 29–145 points) according to Flos[17]. For physical fitness the self-reported fitness on the Groningen Fitness Questionnaire (range 9–45 points)[18] has been used.

All participants gave written informed consent and the research protocol was ethically approved by the Medical Ethics Committee of the University Hospital Maastricht.

Statistical analysis

Data were checked for completeness and normality. Continuous variables were compared between cases and controls using the independent samples *t*-test and dichotomous variables using the χ^2 test. Associations between risk factors and WRULD were estimated by using unconditional logistic regression.

The influence of the following predictors on WRULD was investigated by means of logistic regression analysis: pain catastrophizing, state and trait anxiety, perfectionism, physical fitness, sex and level of education. First, the bivariate associations between the variables and WRULD were investigated. Second, the variables were simultaneously incorporated in a multivariable logistic regression model while adjusting for age, which was considered a potential confounder. Since four continuous predictors were used in our logistic regression model it is necessary to investigate whether the assumption of the linearity of the relationship between the logit and these predictors is violated. We therefore added predictors to the model that are interactions between the continuous predictors and the log of it self. Any significant interaction indicates that the main effect violates the assumption of linearity of the logit[19]. We used a cut-off value of $p<0.10$ for significance of these interaction terms. The explained variance of the multivariable logistic regression model was calculated by means of Nagelkerke's R^2. In general in this study, values of $p<0.05$ were considered statistically significant and data were analyzed by using SPSS statistical software (Version 15.1; SPSS Inc, Chicago, III).

Results

Initially, 78 employees volunteered to participate as a control subject in this study. However, the questionnaires showed that 47 of them had experienced non-specific upper limb pain (WRULD) in the past or had still some pain at present. They were therefore excluded from the study and this resulted in a control group of 31 participants. Data from the case and control groups were complete except for some missing values.

Table 1 shows the values of the socio-demographic, psychological and physical factors of both the case and control group. The socio-demographic data showed a significant difference in age between the case and control group. The mean age in the control group was higher. There were no differences in sex and level of education between both groups.

In table 2 the results are presented of the bivariate associations between the risk factors and upper limb disorders. Both pain catastrophizing (PCS) and lower physical fitness were significantly associated with non-specific work-related upper limb disorders.

Table 3 presents the results of the multivariable logistic regression model on the measured risk factors. None of the interactions between the continuous predictors and the log of it self were significant (i.e. all *p*-values were higher than 0.10) which indicates that assumption of the linearity of the logit was not violated. The case group was significantly more likely to have a higher PCS score (OR=1.37; 95%CI 1.17–1.59; $p=0.00$) and a lower physical fitness score (OR=0.65; 95%CI 0.48–0.87; $p=0.01$) than the control group. No significant associations were found between non-specific upper limb disor-

Table 1. Distribution of socio-demographic, psychological and physical risk factors in the case and control group

	Case group (n=88)	Control group (n=31)	*p*-value
Sex (male/female)	38/50	17/14	0.26
Education (high/low)	59/29	21/9	0.60
Age (yr), mean (SD)	34.0 (7.7)	42.1 (9.3)	0.00
Pain Catastrophizing Scale (0–52), mean (SD)*	24.0 (6.6)	9.8 (8.3)	0.00
State Anxiety Inventory (20–80), mean (SD)*	33.0 (9.7)	32.0 (6.8)	0.54
Trait Anxiety Inventory (20–80), mean (SD)*	34.9 (9.8)	31.9 (7.2)	0.08
Multidimensional Perfectionism Scale (29–145), mean (SD)*	63.0 (17.4)	59.2 (21.7)	0.39
Self-reported physical fitness (9–45), mean (SD)*	26.8 (2.4)	29.6 (3.6)	0.00

*The higher the score, the more the attribute applies.

Table 2. Results of the bivariate logistic regression analyses on risk factors of WRULD*

Risk factor	β	OR	95%CI	p-value
Pain Catastrophizing Scale (0–52)	0.28	1.32	1.19–1.47	0.00
State Anxiety Inventory (20–80)	0.01	1.01	0.97–1.06	0.60
Trait Anxiety Inventory (20–80)	0.04	1.04	0.99–1.09	0.13
Multidimensional Perfectionism Scale (29–145)	0.01	1.01	0.99–1.04	0.34
Self-reported physical fitness (9–45)	–0.33	0.72	0.61–0.85	0.00
Education (high/low)	–0.24	0.79	0.32–1.93	0.60
Sex (male/female)	0.47	1.60	0.70–3.64	0.27

*The analyses were adjusted for age.

Table 3. Results of the multivariable logistic regression analyses on risk factors of WRULD*

Risk factor	β	OR	95%CI	p-value
Pain Catastrophizing Scale (0–52)	0.31	1.37	1.17–1.59	0.00
State Anxiety Inventory (20–80)	–0.10	0.91	0.81–1.02	0.11
Trait Anxiety Inventory (20–80)	0.08	1.08	0.97–1.20	0.16
Multidimensional Perfectionism Scale (29–145)	–0.18	0.98	0.94–1.03	0.46
Self-reported physical fitness (9–45)	–0.44	0.65	0.48–0.87	0.01
Education (high/low)	–0.39	0.68	0.12–3.95	0.67
Sex (male/female)	0.96	2.60	0.48–14.01	0.27

*The analyses were adjusted for age.

ders and state and trait anxiety, and neurotic perfectionism. Nagelkerke's R^2 of the multivariable model was 0.74.

Discussion

The results of this cross-section case-control study show that pain catastrophizing and lower physical fitness are associated with non-specific work-related upper limb disorders. Contrary to the results of other studies, which addressed the role of pain catastrophizing as a prognostic factor of long-term symptoms[20], the present study revealed an association of pain catastrophizing with non-specific work-related upper limb disorders of relatively recent onset (i.e. <12 wk). This may suggest a role of pain catastrophizing in the etiology of non-specific work-related upper limb disorders. Conversely, it may also reflect symptom burden among cases. However, the low average pain scores on the VAS (10 cm visual analogous scale) at baseline (mean score 2.8) seem to contradict this phenomenon. In several other studies, amongst other prospective cohort studies, it has been shown that pain catastrophizing acts as a predictor of chronic pain symptoms. In most of these studies pain catastrophizing predicted chronic states of widespread pain in general[21] or low back pain[22] and in some studies also upper limb disorders[20].

What is remarkable in our study is the fact that 47 out of 78 computer workers who initially volunteered to participate in the control group had to be excluded because of suffering or having suffered from non-specific work-related upper limb disorders. However, they were not aware of it until they had filled out the questionnaire although they were told on beforehand that they were not allowed to have any upper limb symptoms in the past or present. We also calculated the PCS score of the control group as a whole including these 47 participants and still found a significant difference between the "controls" and cases (p=0.00), the "controls" showing significantly less catastrophizing behavior as compared to the cases. Possibly this is the stimulus as to why computer workers with non-specific upper limb disorders and showing pain catastrophizing behavior, not only develop, but are "painfully" aware of their upper limb disorders. In our study the role of pain catastrophizing overruled the impact of neurotic perfectionism and anxiety, found in earlier studies as risk factors[9, 10]. Contrary to the study of Hamberg-van Reenen *et al*.[5] which showed inconclusive evidence for the relationship between low physical capacity and future musculoskeletal pain in a large prospective cohort study, we found an association between lower physical fitness and early non-specific WRULD.

The participants of our intervention study from which the cases in this case-control study were taken, were recruited by means of advertisements in local newspapers, through personal contact with occupational physicians of large companies, and by mailing to general practitioners[12]. This may have resulted in a selection

of participants who differ from an actual health care population in the extent to which they are pre-occupied with their disorder[23]. To increase the validity of this case-control study, the controls were recruited by means of advertisements at the different departments among all levels of university employees who performed similar types of computer screen work as the case group. However, in a case-control study controls should ideally be recruited from the same study base as cases arise. Of the socio-demographic characteristics only age was significantly different between the case and control group. We therefore adjusted for age in the multivariable analysis.

We made use of validated questionnaires. A question that may arise is whether it is possible to measure pain catastrophizing in people without pain as was the case in our control group. Therefore it should be stated that the Pain Catastrophizing Scale has been validated in people without pain[15]. The Groningen Fitness Questionnaire has been validated by Lemmink *et al*. in 2001[24] for the elderly.

As our study has a cross-sectional design, an etiological role of pain catastrophizing or low physical fitness cannot be confirmed. The potential role of pain catastrophizing or lower physical fitness as a risk factor needs to be confirmed in a prospective study with participants who are preferably free of pain at the beginning of the study.

The associations found in this study, in contrast, suggest that both reassurance and proper education on the subject of the risk of (chronic) non-specific upper limb symptoms in computer screen work and stimulation of physical fitness and activity might be valuable strategies to prevent the burden of non-specific upper limb disorders.

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References

1) Brandt LP, Andersen JH, Lassen CF, Kryger AI, Overgaard E, Vilstrup I, Mikkelsen S (2004) Neck and shoulder symptoms and disorders among Danish computer workers. Scand J Work Environ Health **30**, 399–409.
2) Lassen CF, Mikkelsen S, Kryger AI, Brandt LP, Overgaard E, Thomsen JF, Vilstrup I, Andersen JH (2004) Elbow and wrist/hand symptoms among 6,943 computer operators: an 1- year follow-up study (the NUDATA study). Am J Ind Med **46**, 521–33.
3) IJmker S, Blatter BM, van der Beek AJ, van Mechelen W, Bongers PM (2006) Prospective research on musculoskeletal disorders in office workers (PROMO): study protocol. BMC Musculoskelet Disord **7**, 55.
4) IJmker S (2008) Risk factors for arm-wrist-hand and neck-shoulder symptoms among office workers. A longitudinal perspective. PhD Thesis. Body@Work, Amsterdam.
5) Hamberg- van Reenen HH (2008) Physical capacity and work-related musculoskeletal symptoms. PhD Thesis. Body@Work, Amsterdam.
6) Ariëns GA, Bongers PM, Hoogendoorn WE, Houtman IL,Van der Wal G, Van Mechelen W (2001) High quantitative job demands and low coworker support as risk factors for neck pain: results of a prospective cohort study. Spine **26**, 1896–901 (discussion 1902–3).
7) Van den Heuvel SG (2006) Work-related neck and upper limb symptoms. PhD Thesis. TNO, Amsterdam.
8) Koenders PG, Dijkstra L, Bouwman-Brouwer KM, Konijnenberg HS (2006) Een worsteling met de muis (A wrestling with the Mouse). Tijdschrift voor Bedrijfs- en Verzekeringsgeneeskunde (Journal of Occupational and Insurance Medicine) **14**, 57–61 (in Dutch).
9) Van Eijsden-Besseling MD, Peeters FP, Reijnen JA, de Bie RA (2004) Perfectionism and coping strategies as risk factors for the development of non-specific work-related upper limb disorders (WRULD). Occup Med (Lond) **54**, 122–7.
10) Roelofs PD (2002) RSI en persoonsgebonden factoren: een oriënterende studie (RSI, personal and personality factors: an explorative study) University Maastricht (Thesis). http://www.unimaas.nl/bestand.asp?id=2275. Accessed June 23, 2009.
11) Feuerstein M, Nicholas RA (2006) Development of a short form of the workstyle measure. Occup Med **56**, 94–9.
12) Van Eijsden-Besseling MD, Staal JB, Attekum van A, de Bie RA, Van den Heuvel WJA (2008) No difference between postural exercises and strength and fitness exercises for early, non-specific, work-related upper limb disorders in visual display unit workers: a randomized trial. Aust J Physiother **54**, 95–101.
13) Sullivan MJ, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA, Lefebvre JC (2001) Theoretical perspectives on the relation between catastrophizing and pain. Clin J Pain **17**, 65–71.
14) Vlaeyen JWS, Linton SJ (2000) Fear avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain **85**, 317–32.
15) Van Damme S (2002) Pain catastrophizing scale — Dutch version (PCS-DV) University Gent, Gent. http://www.lo-bsw.ugent.be/VVGP/fichePCS.pdf. Accessed March 31, 2009.
16) Van der Ploeg HM, Defares PB, Spielberger CD (1980) Handleiding bij de zelfbeoordelingsvragenlijst ZBV. Een Nederlandse bewerking van de Spielberger state-trait anxiety inventory STAI-DY. (A Dutch version of

the Spielberger state-trait anxiety inventory) Swets & Zeitlinger BV, Lisse (in Dutch).
17) Flos CHGM (1998) Validity and reliability of the frost multidimensional perfectionism scale (Thesis). Faculty of Health Sciences, University Maastricht, Maastricht.
18) Van Heuvelen MJG, Kempen GIJM, Ormel J, Greef de MHG (1997) Self-reported physical fitness of older persons: a substitute for performance-based measures of physical fitness? J Aging Phys Activity **5**, 298–310.
19) Hosmer DW, Lemeshow S (1989) Applied logistic regression. Wiley, New York.
20) Karels CH, Bierma-Zeinstra SM, Burdorf A, Verhagen AP, Nauta AP, Koes BW (2007) Social and psychological factors influenced the course of arm, neck and shoulder complaints. J Clin Epidemiol **60**, 839–48.
21) Keefe FJ, Rumble ME, Scipio CD, Giordano LA, Perri LM (2004) Psychological aspects of persistent pain: current state of the science. J Pain **5**, 195–211.
22) Picavet HS, Vlaeyen JW, Schouten JS (2002) Pain catastrophizing and kinesiofobia: predictors of chronic low back pain. Am J Epidemiol **156**, 1028–34.
23) Feleus A, Bierma-Zeinstra SMA, Miedema HS, Verhagen AP, Nauta AP, Burdorf A, Verhaar JA, Koes BW (2007) Prognostic indicators for non-recovery of non-traumatic complaints at arm, neck and shoulder in general practice —6 months follow-up. Rheumatology (Oxford) **46**, 169–76.
24) Lemmink K, Kemper H, Greef de M, Rispens P, Stevens M (2001) Reliability of the groningen fitness test for the elderly. J Aging Phys Activity **9**, 194–212.