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Work-related musculo-skeletal disorder

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Uwe Osterho
Wilfried Karmau
Brigitte Hullman
Beate Ri

University Hospital Eppendo
Institute of Medical Sociology, Hambu

Textverarbeitun
Monika Michal
Sabine Rauterbe

Graphi
Monika Beck
Uwe Osterho

Bonn 198

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Frese, M.

STRESS AT WORK, COPING-STRATEGIES AND MUSCULOSKELETAL COMPLAINTS

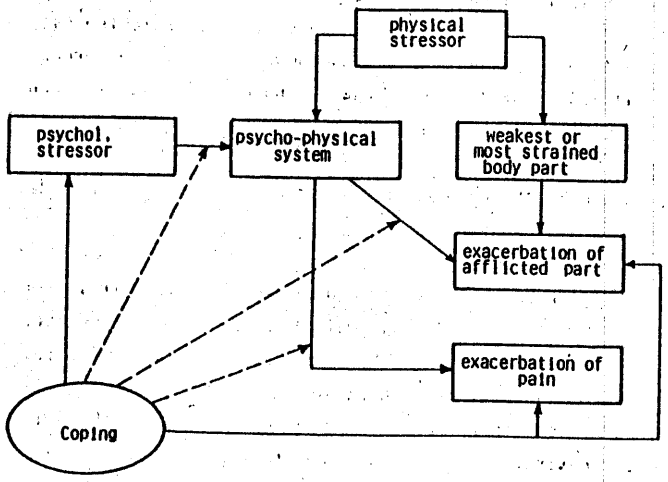
Introduction

Several contributions to this book have pointed to the psychosomatic side of musculoskeletal diseases. This is also the area in which psychology may have something to contribute to our knowledge of the etiology of musculoskeletal disease. The traditional views of psychosomatics (usually referring to psychoanalytic notions) are actually not easily applied to musculoskeletal diseases. One psychoanalytic viewpoint has suggested that the psychosomatic disease has a symbolic relation to the underlying problem. To my knowledge, this model has not been put to a rigorous empirical test and sounds even strained when applied to selected case material. A much more interesting model suggests the breakdown of the weakest part of the psychophysical system when stressors or traumas impinge on the person.

A related but more differentiated theoretical model is suggested in Figure 1. It is argued that psychological and physical stressors have slightly different effects: Psychological stressors impinge on the psychophysical system (and tax its capacity to deal with them); physical stressors do that, as well, but, moreover, weaken certain body parts, e.g. when a certain muscle region is overused or difficult postures have to be consistently maintained in the work place. Furthermore, it is useful to distinguish two problems: the exacerbation of the problems connected to a

certain part of the body and exacerbation of pain. An example for the exacerbation of the afflicted part is when high time pressure causes a tenseness of the muscles which in turn leads to an increase of lower back pain. Additionally, the pain component of lower back pain may also be exacerbated by stressors: the lower back problem may just hurt more when under high stress. It is plausible that the impact of psychological stress is stronger on these two aspects of exacerbation of the musculoskeletal disease while physical stressors produce the wear and tear of certain muscular and skeletal areas. This weakens the respective parts of a system enough to lead to a musculoskeletal disease. (so in a way, physical stressor weaken certain parts of the body that are then affected in an psychosomatic sense).

Figure 1 A theoretical model of stress and coping



Coping can be conveniently classified into two components: problem - focussed and emotion - focussed coping (LAZARUS & LANIER 1978). The former refers to changing the stressor at hand, the latter to changing the emotions that are produced by the stressors. Coping relates to the components of Figure 1 in the following ways:

1) There is a direct path to psychological stressors (actually also to physical stressors but to a lesser degree) when successful problem focussed - coping does away with stressors (e.g. by convincing the supervisor to place the worker into another and less stressful job).
2) Coping can directly reduce the exacerbation of the afflicted body part (e.g. by active relaxation) as well as the exacerbation of pain (e.g. by taking a pain reducing pill).
3) Finally, coping may change the emotions and thus work as a moderator effect (the dotted lines in Figure 1). This means that by reducing emotions, the stressors do not have an impact on the musculoskeletal disease and the pain associated with it. An example would be that a person attempts to forget as quickly as possible a reprimand he got from his supervisor. If he succeeds with this strategy, there will be no exacerbation of the musculoskeletal disease. As this example implies coping attempts do not always succeed. We do not have an a priori knowledge which coping strategies are useful over the long run and which ones are not. (Note: This is also one of the reasons why I follow Lazarus and do not distinguish between coping and defense.)

It is useful to think through a model of this kind. Unfortunately, it is not possible to empirically evaluate the whole model in this article (nor do we have measures for

each aspect of this model). This model was a guide for the study, but the analysis reported here is limited to parts of the model. In this article, I shall concentrate on the following questions: 1) How does stress at work contribute to musculoskeletal complaints? 2) How do various coping strategies contribute to musculoskeletal complaints? 3) Is coping a moderator of the relationship between stress at work and musculoskeletal complaints? Since we do not have a measure of the state of the psychophysical system, coping will be conceived to moderate the relationship of stress at work with musculoskeletal disease. Thus, we are interested to find out which coping strategies are "good" over the long run, i.e. lead to reductions in musculoskeletal diseases and which ones are "bad". At the same time, we shall have to discuss the problem of measuring coping strategies, as well - a problem that has not received the attention it deserves. The questions are answered by analyzing the data from a longitudinal study on stress at work.

Methods

The sample for this longitudinal study consists of 90 male blue collar workers from several different firms in the automobile and steel industries in the Federal Republic of Germany who were studies twice in 16 months (1). There are three groups of variables: the stressors, the coping strategies and musculoskeletal complaints.

Measures of Stress

Stress at work was measured in three different ways: (1) Subjects were asked to fill out a questionnaire on relevant job dimensions.

(2) Trained observers observed the subjects at work for 1 1/2 hours and filled out the same questionnaire items as the subjects.
(3) The third measure was an aggregate, called the "group" level measurement. We had three or more people in the same job, for example three welders, fill out the questionnaire. The median obtained on each dimension was then used as the measure for each person; for example, if three welders gave the answer 2, 3, and 5 for intensity of work, a 3 was assigned to each of them. This index has two advantages: it eliminates idiosyncratic responses (the same way as the observers' judgments do); and it takes the expertise of the subjects seriously.

The following stressors were assessed:
Psychological stress (measured on the subjective, observed, and "group" level) is an index of five different scales on stress at work (which were developed by SEMMER 1982, 1984) that correlate with each other. These are "uncertainty" (e.g. ambiguities, conflicts, and small error-big damage), "organizational problems" (e.g. one does not get material to work with on time), "environmental stress" (e.g. noise), "danger of accidents", and "intensity" (speed) of work.

Physical stress combined two indices (developed by SEMMER 1982, 1984) physical intensity and one-sided stress of parts on the body, e.g. arms, legs, etc.. These indices were also measured on the three levels.

Social stress (developed by the autor) is assessed on the subjective level only. A typical item is: "One is always criticized here; and nobody acknowledges it if one does something well."

Additionally, leisure time stress (developed by BAMBERG 1985) is included because it had been suggested (e.g. by PEARLIN & SCHOOLER 1978) that the choices for coping strategies are different for work stressors than for stressors outside work. A typical item is "I have so much to do that I cannot do anything for my hobby."

The overall study on stress at work did not concentrate only on musculoskeletal complaints because it dealt with a wide variety of psychological and psychosomatic problems. Therefore, only a few items in a questionnaire on psychosomatic complaints (adapted by MOHR 1985) refer to musculoskeletal complaints. Three items on pains in the back, in the shoulder, and in the neck region make up the dependent variable for the analyses reported in this article. Its reliabilities (CRONBACH'S ALPHA) are .77 at time t1 and .89 at time t2. The stability of musculoskeletal complaints across the 16 months is r=.78. This scale also shows meaningful relationships with other related variables. The correlation with the subject's report that a physician had diagnosed musculoskeletal disease was r=.34 ($p<.001$, N=90), with taking pain reducing medication r=.34 ($p<.001$, N=90), and with taking medication against "rheumatism" r=.28 ($p<.004$, N=90) (all of these correlations refer to t2).

Measures of Coping: A situation based questionnaire was used and the answers were grouped across situations. Four different stressors were described briefly, as a vignette, on the top of the questionnaire. The four situations are "When I am under pressure in work, then...", "When something bothers me at work, then...", "When I have an argument with a colleague, then..." and "When I have an argument with my wife or girlfriend, then...". Below each of these four vignettes various alternative strategies were listed and the

subjects were asked to rate each alternative (cf. FRESE, in press, in prep. for more detailed information on the coping scales).

Two prinicpal component analyses in two different cross-sectional studies (which are not reported in this paper) revealed 6 clear and stable factors (the six factors are described in Table 1). With the exception of socially oriented coping, all of the factors can be described as "emotion-focussed" coping.

Table 1 Coping Factors and Sample Items

IF SOMETHING BOTHERS ME IN MY WORK, THEN ...
(Pressure, argument with colleague, argument with spouse)

1) Positive outlook
   "... I say consciously to myself: "Now be calm".
2) Socially focussed positive outlook
   "... I think that there are better sides to him/her".
3) Brooding
   "... I think about it for some days".
4) Socially oriented coping
   "... I ask other colleagues for help".
5) Attention diverting
   "... I try to divert my attention from this".
6) Repression
   "... I swallow down my anger".

In addition to the six factor analytically derived scales there are four more scales on coping (as displayed in Table 2). Two of these relate to pressures at work: denial and avoidance. Avoidance is related to wanting to leave one's job when under pressure. Denial consists of relatively extreme responses about the positive quality of job

pressure. (I do not want to imply that this scale measures denial in a psychoanalytic sense. A more parsimonious explanation would be that it measures a redirection of attention: one looks at the bright side of pressures at work instead of at the negative side.)

Table 2 Additional Coping Scales and Sample Items

7) Denial
"When one is under pressure in work, one is able to show what one can accomplish."
8) Avoidance
"When the pressure at work is high, I think sometimes about changing my job"

Overreporting:

9) Overreporting/deviation from observers
subj. psychol. minus observed psychol. stress
10) Overreporting/deviation from "group"-level
subj. psychol. stress minus "group" psychol. stress

All of the scales described so far are self-report scales. The final two coping scales to be used are indirect measures. As do all indirect measures, they hinge on certain assumptions. It is assumed that coping and defense have an impact on stress perception, a position shared by psychoanalytic (e.g., HAAN 1977, VAILLANT 1977) as well as cognitive theories of stress (e.g., LAZARUS 1966). The argument is that defences reduce the perception of stress, and emotion- and problem-focussed coping have an impact on how threatening a stress situation is perceived to be. It follows then that the difference between the objective stress situation and the subjective perception of it can be

taken as a measure of coping.

Two "objective" indicators of psychological stress were used which are independent of a particular subject's perception: namely, the observers' and "group" estimates. Two deviation scores were derived by subtracting the observers' (or "group") estimates from the subjects' estimate of psychological stress. Thus, the scales measure the deviation between the subject's and the observer's or colleagues' perception of stress at work.

Results and Discussion

Table 3 Stress as a Predictor of Musculoskeletal Complaints (Pearson correlations)

Stressors t1	Musculoskeletal Complaints t2
Obs. psychol. stress	-.02
"Group" psychol. stress	.23*
Subj. psychol. stress	.30**
Obs. physical stress	-.02
"Group" physical stress	.14
Subj. physical stress	.36**
Social stress	.25**
Leisure time stress	.39**

* $p < .05$
** $p < .01$

Stress and musculoskeletal complaints. The question is whether earlier stress at work predicts later musculoskele-

tal complaints at time t2. The results are described in Table 3. In general, earlier stress at work and in leisure time predicts significantly later musculoskeletal complaints. However, there are no significant correlations between the observed indicators of work stress and musculoskeletal complaints. Does this mean that the problems of stress at work are just in the minds of the workers and not objectively there? It is a complicated theoretical problem to elucidate the relationship between "objective" indicators or work stress and stress perception (cf. GREIF 1979 and FRESE 1985). I am not able to do this here. It may be sufficient to point to the fact that there is a significant correlation involving objective stress: Psychological stress measured on the "group" level significantly predicts musculoskeletal complaints. The "group" level index is probably the best "objective" indicator we have in our study. On the other hand, there is reason to believe that objective physical stressors may not be directly related to musculoskeletal complaints since both "objective" indicators show nonsignificant correlations.

Coping and musculoskeletal complaints. Table 4 presents the results on the question whether earlier coping strategies directly affect later musculoskeletal complaints. The correlations are rather small, albeit some are significant. It is interesting to note, however, that contrary to the usual prediction that coping helps to reduce a psychosomatic problem (cf. e.g. LAZARUS 1982), nearly all of the correlations are positive, that is higher coping leads to an increase of musculoskeletal complaints. Overreporting is in line with the hypothesis that a lack of coping leads to musculoskeletal complaints but the correlations of musculoskeletal complaints with emotion-focussed coping strategies like diverting attention, repression, and

avoidance would not be suggested by a cognitive framework of coping but possibly by a psychoanalytic conceptualization.

Table 4 Coping as a Predictor of Musculoskeletal Complaints (Person Correlations)

Coping t1	Musculoskeletal Complaints t2
Denial	-.13
Socially focussed positive outlook	.16
Positive outlook	-.04
Brooding	.07
Socially oriented Coping	.11
Diverting attention	.24*
Repression	.20*
Avoidance	.23*
Overreporting 1 (dev. obs./subj.)	.24*
Overreporting 2 (dev. "group"/subj.)	.07

* $p < .05$
** $p < .01$

Table 5

Significant Moderator Effects of Coping on the Relationship between Stress and Musculoskeletal Complaints (Prediction of Musculoskeletal Complaints t2 by Interaction Terms in a Hierarchical Regression Analysis).

Interaction terms	Beta4
Brooding with	
observ. psychol. stress	-1.07
observ. physical stress	-1.64***
physical stress "group" level	-1.09**
Denial with	
subj. psychol. stress	.93*
Socially focussed positive outlook with	
observed physical stress	.97
Diverting attention with	
physical stress "group" level	.70
Overreporting 1 (dev. obs./subj.) with	
observ. psychol. stress	.82
psychological stress "group" level	1.0
subj. psychol. stress	.68
physical stress "group" level	.46
subj. physical stress	.61***
Overreporting 2 (dev. "group"/subj.) with	
psychological stress "group" level	1.45*

Note: All of the interaction terms increase R by 1%. Some of the Betas are significant (levels $*p < .10$, $**p < .05$, $***p < .01$). The size of the Beta of an interaction term is not interpretable and Betas of more than 1.0 are possible; only the sign, level and the sign can be interpreted.

Coping as a moderator of the relationship between stress and musculoskeletal complaints. Before presenting the results, a few words on the method for detecting the moderator effect are necessary. A hierarchical regression analysis with an interaction term (COHEN & COHEN 1975) with two significance levels was used; first, the significance level for the Beta of the interaction term is .10, as is customary in studies on moderator effects. The moderated regression is quite a conservative procedure for detecting moderator effects. Since there is a scarcity of longitudinal studies in the area of coping and musculoskeletal disease I wanted to be careful not to overlook any moderator effects. Therefore the second significance level conforms to WEEDE's (1977) suggestion: if the moderator term leads to a 1 per cent increment of R^2, this is taken to be significant. Since the question on the moderator effect is on prediction, the dependent variable at t2 was predicted by the independent variables at t1. Thus, the following regression equation is used: Musculoskeletal Disease t2 = a + Beta1 Stresst1 + Beta2 musculoskeletal complaintst1 + Beta3 Copingt1 + Beta4 Stresst1 x Copingt1. A negative sign of Beta4 means that there is a buffer effect (a higher level of coping reducing the impact of stress on musculoskeletal complaints) and a positive sign stands for an enhancer effect (a higher level of coping increasing the impact of stress on musculoskeletal complaints).

There are not very many but a few significant interaction terms (cf. Table 5). One could argue that the number of significant interactions may be largely due to chance; however, there is a clear-cut pattern to the results. For example, there are no significant interaction terms with leisure time stress and social stress. All of the interaction effects involve psychological and physical stress

many of them measured on the "objective" levels. Both physical and psychological stress at work is involved. Interestingly, many of the signs of the interaction terms are contrary to expectation: The positive signs of denial, socially focussed positive outlook, diverting attention and the negative signs of brooding. Again, something like Lazarus' theory is not supported by the positive signs of the Betas indicating that coping enhances the impact of stress on musculoskeletal complaints. On the other hand, brooding - which I had hypothesized to work as an enhancer effect - shows a buffer effect. Apparently, thinking about the stress conditions at work for a long time (=brooding), leads to a reduction of their effect on musculoskeletal complaints. Up to this point, it would be possible to interpret the results within a psychoanalytic framework: Denial, attention diverting, etc. reduce the contact to reality and thus increase the effect of stress on the psychosomatic system, while being keenly aware of the stressors (namely brooding) helps one to deal with them effectively.

However, this interpretation is true only for the self-reported coping scales and not for the indirect measures (overreporting). The indirect indices of overreporting tend to favor the cognitive account against the psychoanalytic ones. A cognitive account of coping would suggest that overreporters show greater stress-effects because they perceive more stress and therefore develop more musculoskeletal complaints. This hypothesis would not follow from an psychoanalytic model because underraters would be conceived to be repressors. They should show the greatest impact of stress on the development of musculoskeletal complaints. As the data demonstrate, it is not the underraters but the overraters (those, keenly aware of the

stressors) who show a higher effect of stress on musculoskeletal complaints. Thus, there is a paradox in the data: The coping factors that directly measure coping via questionnaires, show a moderating effect supporting psychoanalytic theory. On the other hand, the indirect and more objective indicators of coping seem to support a cognitive account.

Due to space consideration, only a sketchy interpretation can be given here. There are two possible interpretations: (1) The direct coping scales measure emotion-focussed strategies while the indirect (overreporting) scales measure the result of problem-focussed coping or the lack of these strategies. The emotion-focussed coping strategies are "bad" and increase musculoskeletal complaints; the problem-focussed coping strategies (leading to underreporting) are "good". Overreporters may be keenly aware of the stressors (thus, they do not repress this information) but they are also not able to deal with the problems at hand in an active way, and, therefore, increase in their level of musculoskeletal complaints. This is substantiated by the direct an by the moderator effect.

(2) The second interpretation I have elaborated elsewhere (FRESE, in press). Briefly, the argument goes like this: A person is only able to answer questions, when he or she consciously represents the thoughts. "Automatic" coping strategies are not consciously represented. People are not consciously aware of things that run smoothly but are or become keenly aware of their actions when the actions do not accomplish the goal or when other problems occur (cf. SEMMER & FRESE 1985). Therefore, checking off a coping strategy on a questionnaire may mean that it is a strategy used in difficult, new and suprising situations. Being in such

situations leads to higher levels of musculoskeletal complaints. Therefore, we are really measuring "problematic" coping strategies when asking direct questions on coping. This methodological reason is responsible for the result that higher coping leads to more musculoskeletal complaints. Ond the other hand, underreporters report less stress because they use coping strategies routinely (and automatic) so that they are not able to report on them. Those automatic strategies are helpful and therefore underreporters show fewer stress-effects (and vice versa, overreporters a higher one).

It is not possible yet to empirically decide between these two alternative interpretations. The first one is supported by the fact, that there is at least one coping strategy (brooding) that has a buffer effect. The second one is well supported in a study using somewhat different methods of analysis and a conceptually broader dependent variable (FRESE, in press). Moreover, there is little reason to think that the concept overreporting/underreporting only refers to problem-focussed coping.

In summary, the following conclusions can be taken from this study. There is an impact of stress at work and in leisure on the development of musculoskeletal complaints. Although many more tests would have to be made to uphold a strict causal relationship, the longitudinal data are consistent with a causal account. Furthermore, the subjectively measured coping strategies (by and large emotion-focussed strategies) are, if anything, "bad", that is they lead to a higher level of musculoskeletal complaints or increase the impact of stress on musculoskeletal complaints. The indirect measures of coping show different results: Overreporting leads to higher levels of musculoskeletal complaints, under-

reporting to lower ones. This is true for the direct and the moderator effect. However, it is not possible at this point, to empirically decide whether methodological or substantive reasons lead to these results, although theoretical arguments speak for the methodological interpretation.

Footnote

(1) This research was part of the research project "Psychological Stress at Work" in which a group of psychologists from Switzerland (U. FELLMANN, I. UDRIS, E. ULICH, Technical University, Zürich) and from Germany (E. BAMBERG, H. DUNCKEL, S. GREIF, G. MOHR, D. RÜCKERT, N. SEMMER, D. ZAPF, Free University, Berlin) including the author of this paper collaborated. The research was supported by a grant from the Bundesminister für Forschung und Technologie, Projektträger "Humanisierung des Arbeitslebens" to S. Greif and E. Ulich (# 01 VD 177 -ZQ - TAP 0016) (GREIF et al. 1983). Additional support for the analysis of the data was given by a grant from the Deutsche Forschungsgemeinschaft to the author. Thanks are due to J. Prümper who did the data analysis.

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