Measures Against Work-Related Stress

- results from a randomized, wait-list controlled trial of a group-based, cognitive behavioural stress management intervention

PHD DISSERTATION

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FACULTY OF HEALTH SCIENCES

AARHUS UNIVERSITY

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The proof of the pudding
is in the eating.

Don Quixote
CERVANTES

List of original papers

This thesis is based on the following original papers, which will be referred to by their roman numerals.

I Willert MV, Thulstrup AM, Hertz J, Bonde JP. Changes in stress and coping from a randomized controlled trial of a three-month stress management intervention. Scandinavian Journal of Work, Environment & Health. 2009;35(2):145–152.

II Willert MV, Thulstrup AM, Hertz J, Bonde JP. Sleep and Cognitive Failures Improved by a Three-Month Stress Management Intervention. International Journal of Stress Management. 2010; 17(3):193–213.

III Willert MV, Thulstrup AM, Bonde JP. Biological markers of stress - results from a randomized wait-list controlled trial of a stress management intervention. (in review in BMC Public Health)

IV Willert MV, Thulstrup AM, Bonde JP. Effects of a stress management intervention on absenteeism and return to work – results from a randomized wait-list controlled trial. Scandinavian Journal of Work, Environment & Health. (online first publication)

Preface

The foundations for the work presented in this thesis were laid in 2005 when the manual for the stress management intervention was developed and pilot tested on two groups of patients at the Department of Occupational Medicine, Aarhus University Hospital. Psychologist Janne Hertz was the principal figure in the early stages of the project and was involved in developing the treatment manual as well as writing the original grant application to the Danish Work Environment Research Fund. Without these early efforts the research project would never have lifted off the ground.

Since then many people have contributed in the process of designing and carrying out the research project. Notable among these are my two main supervisors, Ane Marie Thulstrup and Jens Peter Bonde, who have helped foster and inspire many of the ideas that have become central to the research project which was eventually to be named *Measures Against Work-Related Stress*, in short the MARS project.

Working with a clinical epidemiological research project has been a rewarding journey; at times offering the feeling of conquering inaccessible pinnacles and enjoying great vistas – and at times inspiring the feeling of being stuck in a dead end up some deep valley, and having to retrace one's steps to get back on track. I wish to extend my gratitude to all those who have stuck with me on this journey and generously given their time and inspiration when it was most needed.

I hope the thesis reflects the gains achieved from this journey, and will inspire new discussions and reflections on the understanding of the concept of stress and the effects of stress management interventions.

Aarhus, July 1, 2010
Morten Vejs Willert

List of abbreviations

Biomarker	Objective measurement used as an indicator of a biological state
CI	Confidence Interval(s)
DC/DC-S Model	Demand-Control/Demand-Control(-Support) Model
DREAM	Den Registrerede Evaluering Af Marginalsamfundet (In english: The registered evaluation of the marginal society) A database of public transfer payments, administered by The Labour Market Authority (Arbejdsmarkedsstyrelsen)
ERI Model	Effort-Reward Imbalance Model
GP	General Practitioner
I-group	Intervention group
ICD-10	International Classification of Diseases, Tenth edition, WHO
MARS	Acronym for the research project Measures Against work-Related Stress (In danish: Midler mod Arbejds-Relateret Stress)
OR	Odds Ratio
PSS-10	Perceived Stress Scale, 10-item version
RCT	Randomized Controlled Trial
SD	Standard Deviation
SF-36	Short Form 36-item questionnaire from WHO
WAIS-III	Wechsler Adult Intelligence Scale, 3rd edition
WHO	World Health Organization
WLC-group	Wait-list control group

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1 Introduction

1.1 Work-related stress in a societal context

In the past decade there has been an increased awareness in Denmark of the relationship between psychosocial working conditions and subjectively experienced psychological and physiological health complaints, the latter in daily terms often labeled *stress*.

There has been an increased focus on the proportion of sickness absence that can be ascribed to psychosocial working conditions. The amount of sickness absence attributable to dimensions of psychosocial work conditions has been estimated at 29% [1], meaning that roughly one in four cases of sick leave is related to psychosocial work conditions. The Danish Ministry of Employment has estimated that the work of approximately 140.000 full time employees is lost every year in Denmark due to all types of sickness absence [2]. Putting the above estimates in relation to one another, an estimated 35.000 danes are on sick leave on any given day in relation to work-related psychosocial stressors.

Similarly, the number of compensation claims on grounds of affective disorders in relation to working conditions has seen a five-fold increase in Denmark over the past 10 years; from 483 claims of compensation to the National Board of Industrial Injuries in the year 1999, to 3049 claims made in 2009.

The above outlined changes reflect a more general trend regarding the burden of mental health problems in western societies. A recent Danish white paper on Mental Health Problems and Return To Work estimates that the cost of mental health problems in Denmark poses an annual burden of €7.4 billion (55 billion d.kr.) [3]. In addition, the WHO forecasts that mental health problems, in the form of unipolar depression, on a global scale will represent one of the leading disease burdens by the year 2030 [4].

Concurrent with the national and international trends outlined above, there had—from the late 1990's an onwards—locally been a steady rise in patients referred to the the Department of Occupational Medicine, Aarhus University Hospital, for an assessment of the relationship between psychosocial work conditions and the patient's

symptoms or inability to work.

These assessments would mainly be carried out by the psychologists working at the Department of Occupational Medicine. In the interviews with the patients there was at first the challenge of evaluating the strength of the possible causal link between the patient's work environment and the symptomatology of the patient, but secondly—and just as important—there was the task of how to counsel the patient regarding steps that would lead to recovery from his or her symptoms, and a return to better well-being, or performance, at work.

The initiative to launch the current research project, the MARS project, was based on the above outlined national and local tendencies, that brought to the surface the question of: What are effective measures against work-related stress, once it is present for the individual?

1.2 Structure of the thesis

In the following paragraphs a short overview of the structure of the thesis is presented.

Following the introduction in chapter 1, the theoretical and scientific background for the the thesis is outlined in chapter 2. This includes an outline of theories of stress in general and theories of stress in relation to work in particular. Also, a cognitive behavioural understanding of work-related stress within a biopsychosocial framework is presented. Then follows an introduction to the effects of psychological interventions in general, and more specifically the effects of cognitive behavioural interventions. Lastly, three levels of stress prevention are outlined and related to the present study.

Following from the general introduction to the field of stress research and efficacy of psychological interventions, chapter 3 comprises results from two reviews of the literature undertaken in conjunction with MARS study. The first literature review presents identified systematic reviews of a wide range of stress management interventions. After this follows a review of identified studies that are comparable to the MARS study in terms of study design, scope of the intervention, and outcomes measured.

The aims of the thesis are presented in chapter 4.

In chapter 5 the population sample and methods of the MARS study are presented. This includes the study design, sample size, randomization procedure, mea-

surement points and time line of the trial, conceptualization of stress in the MARS study, eligibility and assessment procedures, allocation and drop-out, a description of the MARS intervention protocol for all eight group sessions, outcome measures used, and the statistical methods employed.

Then follows the results in chapter 6, where baseline characteristics of the participants are presented, as well as condensed presentations of the results from the four original papers that the thesis builds on. This comprises results on changes in perceived stress and coping (Paper I), sleep and cognitive ability (Paper II), biological markers of stress (Paper III), and absenteeism and return to work (Paper IV).

In the discussion in chapter 7 the main findings from the MARS study are discussed. Also, the efficacy of the MARS intervention is compared both to the original studies and to the meta-analyses identified in chapter 3. The findings are then contrasted to the theories of stress and the general efficacy of psychological interventions outlined in chapter 2. Then follows a presentation of the strengths and limitations of the MARS study. Finally, an assessment of the relevance of the findings from the MARS study is given.

In chapter 8 the conclusions of the MARS study are presented in relation to the aims of the thesis.

Finally, in chapter 9, perspectives for future research are outlined.

2 Background

2.1 Outline of theories of stress

It is difficult to address the concept of *work-related stress* without first giving some attention to the concept of *stress* itself and the theories of stress that have been proposed in the past 100 years.

The concept of stress has been used in academic circles in a number of —sometimes contradictory—ways in the fields of psychology, medicine, and biology since the beginning of the 20th century. The word stress stems from the latin word *strictum* which means to tighten or draw together. Originally the concept of stress was borrowed from building construction where stress referred to the load a given point in a construction when it was subjected to an external load.

From 1914 and onwards Walter Cannon [5] proposes the fight-or-flight hypothesis to describe the physiological changes that occur in animals and man when subjected to acute danger. Cannon's work is primarily centered around the acute stress response, which is characterized by activation of the sympathetic nervous system, resulting in increased activation of basic physiological functions, such as blood pressure and pulse, muscle tone, and release of hormones such as epinephrine and norepinephrine in the blood stream.

Beginning in the 1930s biologist Hans Selye [6, 7] proposes findings detailing the physiological effects resulting from long-term exposure to what he labels stressors, such as heat, cold, or forced exercise, examined in animal models. He found that long-term exposure to stressors results in heightened activity of the hypothalamic-pituitary-adrenal (HPA) axis producing, among other effects, higher levels of the hormone glucocorticoid in the blood stream, changes in the metabolism of sugar and fat, decreased excretion of growth hormones, disturbed sleep, apathy and/or lowered threshold for aggression, and lowered problem solving skills especially involving memory and concentration tasks. Selye labeled this response the *General Adaptation Syndrome* (GAS), but which we now call the *stress-response* [8].

One of Selye's major contributions was the possible links he proposed between long-term activation of the stress-response and increased risk of certain diseases, such

as hypertension or inflammatory diseases, which were investigated in animal models. [9]

Cannon and Selye's findings on the biology of the stress-response were based to a large degree on animal studies in a laboratory setting. However, in humans our understanding of the experience of stressors and the subsequent stress-response may be extended, as we in our capacity as humans have extended capacity for problem solving and larger degrees of freedom in our actions, compared to (laboratory) animals.

The coping theory of Lazarus and Folkman [10], first published in 1984, takes into account these extended human capacities in the understanding of the human stress-response. Lazarus and Folkman propose that, following the acute stress reaction described by Cannon, a primary and secondary cognitive appraisal of the situation takes place. The primary cognitive appraisal concerns the question "Am I in any danger?", while the secondary cognitive appraisal deals with the question of "Is there anything I can do about it?". The cognitive appraisal of the situation may elicit coping behaviour on part of the individual, aiming at re-establishing the balance between outer demands and individual resources. Coping behaviours may take a number of forms, such as removing oneself from the stressor, seeking instrumental or emotional support from others, attempting to eliminate the stressor, etc. However, there may be situations where the coping responses do not suffice and the individual continues to experience a mismatch between environmental demands and inner resources to cope adequately. It is under such circumstances that long-term stress can occur, according to the theory of Lazarus and Folkman.

The most recent theory concerning the stress-response is labeled the Cognitive Activation Theory of Stress (CATS) [11, 12, 13], which has been proposed by Holger Ursin and Hege R. Eriksen from the University of Bergen. The CATS theory represents a synthesis of the formerly proposed biological and psychological perspectives on the stress-response. Furthermore they introduce the concepts of *learned helplessness* to explain how the individual may be trapped in a sustained negative cycle.

Learned helplessness is a term coined by psychologist Martin Seligman [14], and

describes a behaviour pattern where the individual does not cope adaptively to an environmental stressor, based on prior experiences where coping responses have been futile. Seligman's research originally demonstrated learned helplessness in dogs that were subjected to inescapable electric shock, but the behaviour pattern has been extended in studies of rats, cats, fish, mice, and humans, as well as to other environmental stressors. A subject with learned helplessness is characterized by passivity in the face of new encounters with the environmental stressor to which it was conditioned to learn helplessness, and also exhibits retarded learning of new ways to control or escape the environmental stressor, when compared to subjects that have not been preconditioned with learned helplessness to the environmental stressor. Learned helplessness has been associated with both psychological stress, expressed as increases in negative affectivity, and physiological stress, expressed as changes in HPA axis activity [15, 16].

Stress is, according to the CATS theory, a state that arises when the individual through an extended period of time has experienced sustained cognitive activation caused by an environmental stressor, that is perceived as distressing and that the individual has developed a negative expectancy of being able to cope with. This accumulation of negative expectancies, and their role in maintaining the stress-response, is a core component of the CATS theory.

In the MARS-project the coping theory of Lazarus and Folkman was the most influential theory behind the formulation of the intervention manual. The modern extensions of the biological theories of Cannon and Selye guided the formulation of the biological markers of stress that were included as outcome measures. The CATS theory is still relatively new and was not an explicit part of the formulation of the MARS project. However, since the CATS theory aims to integrate biological and psychological perspectives in understanding stress, it may be relevant to discuss the results of the MARS intervention in relation to this theory.

2.2 Theories of work and stress

Two major theories of the relationship between stress and work have dominated the field in the last three decades – the Demand-Control(-Support) model and the Effort-

Reward Imbalance model.

In 1979 psychologist Robert Karasek proposed the Demand-Control (DC) model to explain the emergence of what he termed *job strain* [17]. Extending on previous models, that had looked either demands or decision latitude separately, Karasek advocated that is was the interaction effects of high demands and low decision latitude that placed the individual in the highest risk of job strain. Later the Demand-Control model was extended to include the moderating effect of social support on the development of job strain from the interaction of demands and control. This extended model was labeled the Demand-Control-Support (DC-S) model.

Since their emergence the DC and DC-S models have received much attention and have been implemented in a number of different studies. Over time the design of the studies have improved, from the early cross-sectional studies, to longitudinal study designs. In a recent comprehensive review of studies on the DC-S model by Häuser et al. [18] the authors find that the effect of job characteristics on psychological well-being was lower in longitudinal studies compared to cross-sectional studies, and that there is little support for an overall interaction effect of demands and control, above the effect of each dimension in itself.

The lack of support for an interaction effect of demands and control questions the original formulation of the DC model by Karasek in 1979 [17], where the interaction effect was the key point that separated the DC-model from previous models that had looked at demand and control separately.

In the 1990s a second major model on the relationship between stress and work, labeled the Effort-Reward Imbalance (ERI) model, is proposed by sociologist Johannes Siegrist [19, 20]. This model states that long-term spells of imbalance between the efforts the individual puts into meeting the demands and obligations of his/her job, and the rewards (i.e. wages/salary, esteem/recognition, promotion/security) the individual receives from doing the job, may have adverse health effects. An interaction effect of an effort-reward imbalance with workers' degree of overcommitment to work tasks is also proposed.

The ERI model is suited to investigate the factors that influence individuals working in knowledge and service occupations in the information society [21], better, perhaps, than the DC(-S) model which is rooted in working conditions of the industrial

society.

There have been performed several studies on the ERI model in relation to psychological health. In a recent review by Siegrist [22] ERI is found to be related to depression, all though methodological limitations of the included original studies limit the possibility of drawing firm conclusions regarding causality. Some studies have found support for the interaction effect of on the one side an effort-reward imbalance of high effort and low rewards, and on the other side high or low degree of overcommitment to work tasks [21, 23].

A common criticism of research on the DC, DC-S and ERI models is the phenomenon of common method variance, which may limit the inferences of causality one can draw in epidemiological research [24, 22]. Common method variance refers to the fact that a large portion of studies that have found an association between factors in the working environment and health parameters rely on a single source of information – the individuals subjective experience of his/her working conditions and the individuals subjective experience of his/her symptoms of psychological well-being. As noted by Häuser et al. [18] it may well be that the association between work and health is partly be due to reciprocal causation — that worker's health may affect both job characteristics and their evaluation of the working environment. However, the theoretical models, research methodology and statistical methods suitable for studying this entangled web of intricate and reciprocal causative factors, are yet to be fully developed and refined.

In research of the DC, DC-S and ERI models smaller odds ratios (OR), typically OR<2, have been found in studies that are prospective and use objective measures of the psychological health outcomes, compared to studies that are cross-sectional and use subjective ratings of psychological health as their outcome.

In conclusion, different work characteristics have been proposed as risk factors for impaired psychological well-being and health, but the assumption of monocausality from work characteristics to detrimental health effects has been challenged by more sophisticated, longitudinal studies. The overall results support viewing work characteristics, psychological well-being and health as part of a system of mutually influencing factors.

2.3 Stress in a biopsychosocial framework

The concept of stress can, as detailed in the above sections concerning different understanding and theories about stress, be viewed from both biological, psychological and social perspectives.

In humans stress may be viewed as a state that is dependent both on the biological conditions that is part of our evolutionary heritage, on the results of the interplay between each persons unique genetic variability and the environment (s)he has been raised in and continue to live in, and of the culturally determined circumstances that we are exposed to as part of society.

This view of stress is in line with the biopsychosocial model proposed by George L. Engel more than 30 years ago [25], which continues to be explored in our understanding of the complex interplay between the biological, psychological and social components of health and disease [26, 27].

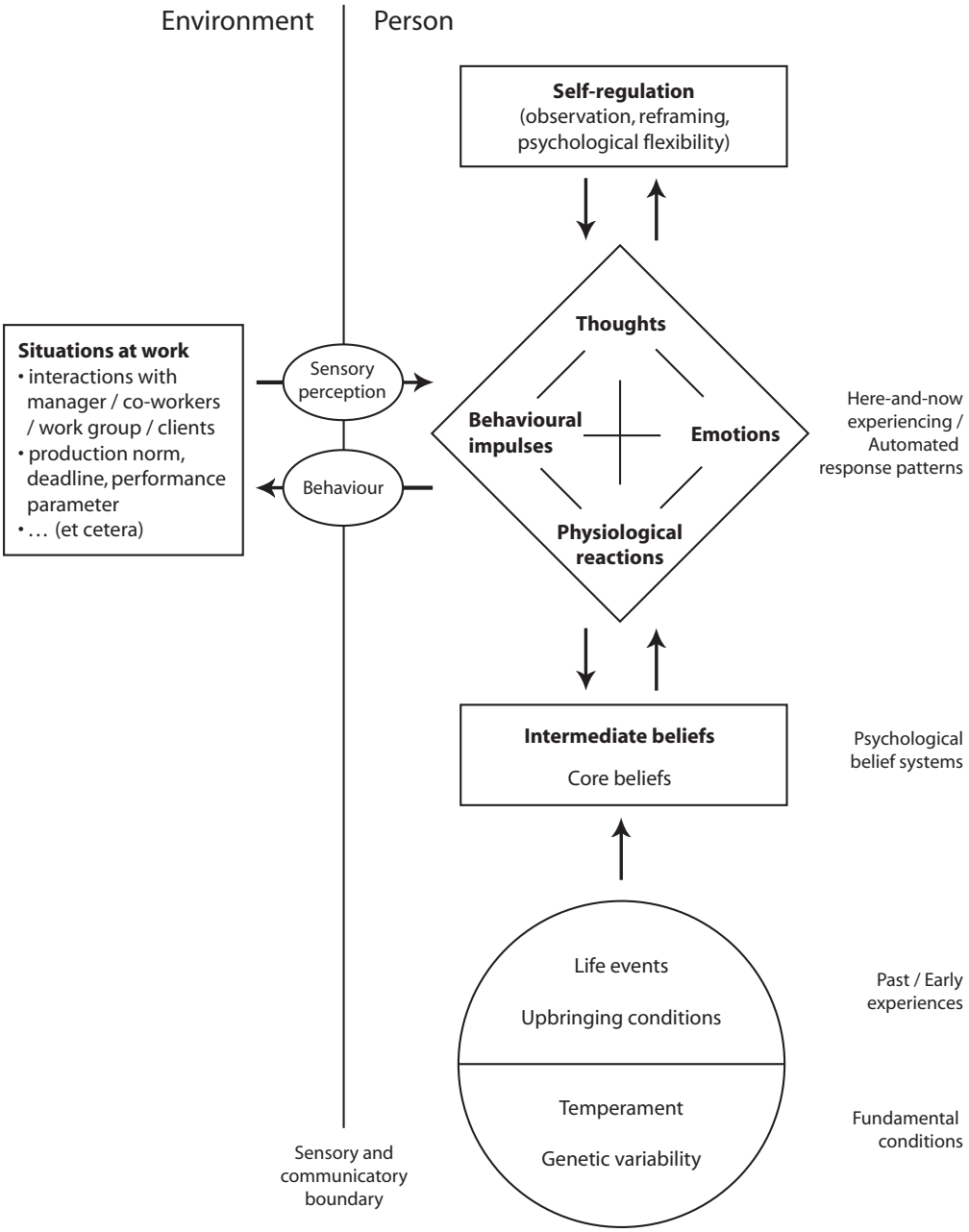
A cognitive behavioural model of work-related stress

The MARS intervention was based on a biopsychosocial understanding of stress and utilized the rationale behind cognitive behaviour therapy as a vehicle for the intervention. In Figure 2.1 (p. 11) a cognitive behavioural model for understanding work-related stress within a biopsychosocial framework is presented.

The model is based on the basic assumption behind cognitive behavioural therapy, the *cognitive model*, which hypothesizes that people's emotions and behaviours are influenced by their perception and interpretation of events. It is an assumption in cognitive behaviour therapy that situations in the environment in and of themselves do not elicit our emotional or behavioural reactions, but rather that our reactions follow from the way in which we *construe* a situation. Hence, the pivotal role of *cognitions* in cognitive behaviour therapy [28, 29].

The model outlines—starting from the circle in the bottom right of the figure—how early experiences during upbringing, in an interplay with fundamental conditions such as temperament and genetic variability, are hypothesized to form the basis for the formation of psychological belief systems regarding ourselves, others and the world. In the cognitive behavioural tradition these belief systems are conceptualized in the form of core beliefs ("The world is a good / bad place", "I am worthy / unwor-

Figure 2.1: A cognitive behavioural model for understanding work-related stress in a biopsychosocial framework. (Modified after A.T. Beck (1979) and J.S. Beck (1995))



thy", etc.) and intermediate beliefs ("If I [*insert compensatory behaviour or attitude here*], then I am good / worthy / etc.") [29].

Built on the foundation of the psychological belief systems are the processes that occur in the here-and-now, in the model represented by the cognitive diamond; comprising *thoughts*, *emotions*, *physiological reactions*, and *behavioural impulses*. The processes within the cognitive diamond can be unique in relation to the present moment, but may also be examples of automated response patterns, that constitute the individuals' habitual response to a wider range of situations [29].

Interactions between the person and the environment take place across the sensory and communicatory boundary, in the model represented by a vertical line. The person picks up sensory information about the environment, in the model exemplified as situations at work, and responds through behaviour and communication directed back at the environment, or in the model, the situations at work.

Within this model, work-related stress may be defined as a state where the individual experiences intense negative or unpleasant thoughts, emotions, and physiological reactions in relation to critical situations at work, and has not been able to regulate this state of negative experiencing either internally through self-regulation, through interactions with the environment, or through modification of intermediate beliefs.

Dealing with work-related stress in the context of cognitive behaviour therapy implies working with three feedback loops; in the model designated by arrows going both to and from the cognitive diamond:

1. **Enhancing self-regulation:** The first feedback loop entails working with the individuals' self-regulation, through observation of the processes that occur within the cognitive diamond, reframing or restructuring of dysfunctional thought patterns, and at a general level working towards enhancing the individuals' psychological flexibility.

2. **Improving interaction:** The second feedback loop concerns improving the range—or repertoire—of ways of interacting with the environment. This implies differentiating 1) what goes on in the environment (in the model outlined as different work situations), 2) the sensory information I pick up about the en-

vironment, or work situations, and 3) the processing—and possible distortion—of this information that takes place within the cognitive diamond. Improved self-regulation and registration of behavioural impulses form the basis for formulating alternative forms of communication and behaviour directed at the environment, that may influence the ability to interact adequately with others and provide a greater sense of control over situations at work.

3. **Modifying intermediate beliefs:** The third feedback loop relates to the individuals' psychological belief systems. Through analysis of a number of typical situations, hypotheses regarding the nature of the individuals' intermediate and core beliefs may be proposed. From a critical assessment of the intermediate beliefs in terms of their functional role, possible origins in early experiences, and current usefulness in handling critical situations at work, it is possible to formulate alternative phrasings of the intermediate beliefs, that may be more functional in relation to the individuals' current situation.

2.4 The effects of psychological interventions

General introduction

Psychological treatments have been evaluated extensively in the past 50 years and overall psychotherapy is found to be an efficacious treatment for a range of psychological disorders, including depression, anxiety and phobias [30]. Meta-analytic reviews of this research has shown that around 75% of those entering treatment gain some benefits compared to an untreated control group [31].

Over the years different theories and treatments models have evolved, among these psychoanalysis, psychodynamic therapy, interpersonal therapy and cognitive behaviour therapy, all of which have had their efficacy tested in clinical trials. However, there has been much debate over which treatment modality is the more effective treatment. In a meta-analysis of studies that compared different treatment modalities within the same trial, Wampold et al. [32] coined the term "bona fide psychotherapies" which encompasses therapeutic interventions that were delivered by trained therapists, were based on psychological principles, were offered to the psychother-

apy community as viable treatments (e.g., through professional books or manuals), or contained specified components. In their review and meta-analysis of studies that compared bona fide psychotherapies of different treatment modalities, Wampold et al. conclude that there is little to suggest that the different forms of treatment offered resulted in changes in the magnitude of the overall effect of psychotherapy. The authors conclude, along the lines of the Dodo bird from Alice in Wonderland, that "everybody wins, and all must have prizes", a conclusion that is known in the literature as the "Dodo Bird Verdict".

However, the Dodo Bird Verdict has been challenged with respect to specific treatments, among these the treatment of certain anxieties and phobias, where cognitive behavioural interventions appear to be the more effective treatments [33].

The dose-effect relationship in psychotherapy

As early as 1986 Howard et al. published a paper on the dose-effect relationship in psychotherapy. Based on data from patients receiving psychotherapy in a psychiatric care setting, they were able to show a positive relationship between the number of treatment sessions received and the percentage of patients that improved.

In a graphical representation the positive relationship between number of session and percentage improved shows a negatively accelerated curve. This implies that one can expect relatively more improvement in the early stages of treatment, compared to later stages in treatment. It also implies that as treatment progresses more sessions are needed later in treatment to make noticeable increases in the percentage of patients that improve.

It has been shown that the number of patients improving from psychotherapy is dependent on the initial level of distress, implying that patients with more severe conditions take a longer time to recover and need more sessions to improve noticeably [30]. Anderson & Lambert [34] have studied the time to attain a reliable change on an outcome questionnaire measuring symptomatic distress, interpersonal functioning and role performance at work or school, in an outpatient setting including patients with both high and low levels of distress at intake. They found that 50% of the patients improved reliably following 7 sessions of treatment, and 75% had improved by their 14th session.

Another question with regards to efficacy of psychotherapy is whether there are significant differences in the magnitude of outcome between individual and group-based treatments. In a meta-analysis of previously published reviews, McRoberts et al. [35] have looked into this, and found that individual and group-based interventions produce similar effect sizes. In a cost-effectiveness perspective this could favour the use of group-based intervention formats in clinical settings where sufficiently large number of clients share the same type of problems.

The effect of Cognitive Behaviour Therapy

Cognitive Behaviour Therapy is one of the most investigated forms of psychological treatment. It is characterized by providing specific treatment rationales for a diverse range of conditions, originating with the treatment of depression formulated by Aaron T. Beck in 1979 [28], and later evolving to cover the treatment of anxiety, PTSD and personality disorders [36, 37]. The specificity of the interventions suggested in cognitive behaviour therapy fits well with the rationale of randomized controlled trials, were reproduceability of a treatment and manualization of the steps followed are highly valued.

In a comprehensive review of meta-analyses of cognitive behaviour therapy Butler et al. [37] conclude that cognitive behaviour therapy is an effective treatment for a range of psychological problems. They found large controlled effect sizes (d=0.90) for unipolar depression, generalized anxiety disorder, panic disorder with or without agoraphobia, social phobia, and childhood depressive and anxiety disorders. (For an explanation of using effect sizes to estimate intervention effects, see section 5.12, p. 41). When followed up after termination of treatment, the gains achieved are generally maintained, all though as the follow-up period after treatment extends, more and more extra-therapeutic factors may influence the course of symptomatology for the patients.

2.5 Levels in stress prevention

In epidemiology a distinction is made between primary, secondary and tertiary prevention strategies. In a psychosocial occupation health perspective this translates

into; *primary preventions* aimed at reducing the causes of stress, traditionally modeled after the Demand-Control-Support and Effort-Reward Imbalance models; *secondary interventions* aimed at enhancing the general workers ability to handle stressors at work, traditionally achieved through workshops, information and awareness campaigns, and the like; and *tertiary preventions* aimed at rehabilitating workers with elevated symptoms of stress or ill health [38].

As will become evident in the next chapter, the majority of the literature has traditionally focused on primary and secondary prevention strategies, while relatively less attention has been given to tertiary prevention interventions, of which the MARS study is an example.

3 Literature review

In this chapter the search of the literature that was conducted in relation to the MARS project is outlined, and the results are commented upon. Two different searches were performed; one for published systematic reviews of stress management interventions, and one of published original studies that were comparable to the MARS study. These two searches are described below.

3.1 Identifying systematic reviews

In October 2007 a search of the literature was conducted, aiming to identify published systematic reviews on the effects of psychological stress management interventions. The search was performed in PubMed, PsycINFO and the Cochrane Database of Systematic Reviews.

The definition of a systematic review was set according to the definition proposed by Chalmers and Altman [39] stating that a systematic review is a review that has been prepared using a systematic approach to minimizing biases and random errors which is documented in a materials and methods section. This includes a priori setting selection criteria detailing study designs, outcomes, etc. that a study must conform to in order to be eligible for inclusion in the review. It also includes accounting for the search strategy employed, what keywords were used, what databases were searched, what were the specific search strings used in the different databases, and how was the process of excluding papers on basis of their title, the abstract, full text reading, and so on. A systematic review may—or may not—contain a meta-analysis of the pooled results from the assembled original studies contained in the review.

Search strategy and results

In PubMed a total of 329 potentially relevant reviews were found, using the search string *stress[mesh] AND (work OR occupation OR occupational medicine OR stress management)* and limits set to *Humans; Meta Analysis; Review; English*. This number was reduced to 11 when selecting on title, and further reduced to 2 reviews after

selection on abstract. After reading the full text none of the two identified papers qualified as a systematic review

In PsycINFO a total of 187 potentially relevant articles were found, using the search string *DE=("occupational stress" OR "stress management") AND KW=("work" OR "occupation" OR "occupational medicine" OR "stress management")* and limits set to *Journal Article; English; Humans; Litterature review, Systematic review, Meta Analysis*. After reading the titles this number was reduced to 34, which was further reduced to 11 reviews on basis of their abstracts. After reading the full text six systematic reviews [40, 41, 42, 43, 44, 45] were identified.

A search of the Cochrane Library with the MeSH-term *Stress* resulted in three reviews; one of which was found to be a systematic review of stress management interventions [46].

In the identified systematic reviews, references were found to earlier reviews in the field. Five such earlier reviews were identified and retrieved in full text. None of these earlier reviews qualified as a systematic review.

Since the initial search was performed in 2007, one more systematic review has been published [47], and is included in the current overview.

Evaluation of the identified reviews

A total of eight systematic reviews on the effects of stress management interventions were found from the literature search described above. Key characteristics of the eight reviews are outlined in Table 3.1 (p. 19). When comparing the reviews it is clear that the methodological rigour of the reviews has evolved, and especially the reviews of Marine et.al. [46] and Richardson & Bryant [47] set a new high standard in methodological quality.

The number of included RCTs is another feature that has evolved, as more high quality studies have come out in recent years. The Richardson & Bryant [47] review is the first to include only RCTs, where all previous reviews have included non-randomized trials and also some trials with no control group, presumably because of a lack of randomized, controlled trials at the time.

Most of the reviews focus on trials that include only members of the working population, and coming from a range of occupations. Exceptions to this are the reviews

Table 3.1: Identified systematic reviews of the effects of stress management interventions.

Author (year) (nationality)	Years covered	*n* studies included	Study designs	Participants and occupation	Severity of symptoms	Intervention level(s) (*n* CBT)	Outcomes included	Effect size of interventions
Richardson (2008)(USA)	1976–2006	36	RCT(36)	Working population Diverse Occupations	Clinical and non-clinical	Individual (7 CBT) Organizational	Psychological Physiological	Medium to large(CBT)
Marine (2007)(Multi)	1966–2005	19	RCT(14), CT(5)	Working population Healthcare Workers	Clinical and non-clinical	Individual (7 CBT) Organizational	Psychological Physiological	Small to large(CBT)
Giga (2003)(UK)	1990–2001	16	RCT(6), CT(5) and T(5)	Working population Diverse occupations	Clinical and non-clinical	Individual (7 CBT) Organizational	Psychological Absenteeism	
van der Klink (2001)(NL)	1977–1996	48	RCT(?) and CT(?)	Working population Diverse occupations	Clinical and non-clinical	Individual (18 CBT) Organizational	Psychological Physiological	Small to medium(CBT)
van der Hek (1997)(NL)	1987-1994	24	RCT(?), CT(?) and T(13)	Working population Diverse occupations	Clinical and non-clinical	Individual Organizational	Psychological Physiological Absenteeism	
Murphy (1996)(USA)	1974–1994	64	CT(47) and T(17)	Working population Diverse occupations	Clinical and non-clinical	Individual	Psychological Physiological Absenteeism	
Saunders (1996)(USA)	?–1991	37	CT(37)	Working and non-working population	Clinical and non-clinical	Individual (37 CBT, Stress Inoculation Training)	Psychological	
Godfrey (1990)(?)	?–1990	17	RCT(5), CT(?) and T(?)	Working population Diverse occupations	Clinical and non-clinical	Individual Organizational	Psychological	

by Marine et.al. [46], focusing exclusively on healthcare workers, and Saunders et.al. [41], where trials of both the working and the non-working population are included.

All the identified reviews include trials both with and without selection on symptom severity as an inclusions criteria, i.e. both clinical and non-clinical samples. The numbers from the van der Klink et.al. [44] review show the typical weighting between these two types of trials; only four of the included 44 studies had selection on symptom severity at inclusion to the study. One can speculate that inclusion of studies with non-clinical samples potentially underestimate the effect of an intervention as a clinical tool, since it is always harder to detect a pre-post difference on a symptom scale, if participants are close to normal at baseline.

Most reviews include studies directed at the individual and the organizational level, and some directed at both levels at the same time. In none of the reviews was there a selection on the volume of the interventions in terms of the number of sessions or contacts participants receive. The included original studies typically range from relatively short interventions in a workshop format, to longer interventions with five or more sessions in a talk therapy format.

All in all, this implies a large heterogeneity of the included studies in each review, in terms of both the level they intervene on and the amount of impact that they have the potential to produce. Furthermore the psychological and physiological outcomes used in the different studies have a wide variation, and are thus hard to compare.

A feature of three of the reviews, Richardson & Bryant [47], Marine et.al. [46] and van der Klink et.al. [44], is that they provide results from meta-analyses of the included studies. Because of the large heterogeneity of the studies they include, effect sizes are reported separately for cognitive behavioral interventions, relaxation interventions, and organizational intervention, as well as multi-modal interventions. The effect sizes, expressed in terms of Cohen's d [48] range from small (d<0.5) to large (d>0.8), according to the conventional interpretation of effects sizes proposed by Cohen. Generally individual level interventions based on cognitive therapy achieve the highest effect sizes (Richardson & Bryant: d=1.16(0.46;1.87) [47], Marine et.al.: d=0.85(0.49;1.21) [46], van der Klink et.al.: d=0.68(0.54;0.82) [44]).

3.2 Identifying comparable original studies

To allow for comparison of the results from the MARS project with previous studies in the field, a search for comparable studies published in peer-reviewed journals was conducted. The applied search strategy and the studies identified are presented below.

Search strategy and results

Original papers on studies comparable to the MARS study were identified through searches of the PubMed and PsycINFO databases, and The Cochrane Central Register of Controlled Trials.

In PubMed 2283 articles were identified using the search terms *"Stress"[Mesh] OR "Stress Management" OR "Stress Intervention" OR "Stress Prevention" OR "Occupational Stress" OR "Occupational Health" OR "Occupational Medicine" OR "Job Stress" OR "Work Stress"* and the limits *Humans, Clinical Trial, Randomized Controlled Trial, English*. By selection on title this number was reduced to 81, and further reduced to 26 articles based on the abstracts.

In PsycINFO a total of 494 potentially relevant articles were identified using the search terms *Thesaurus: occupational stress, stress management, KW=("stress" or "occupational stress" or "stress management" OR "Stress Intervention" OR "Stress Prevention" OR "Occupational Stress" OR "Occupational Health" OR "Occupational Medicine" OR "Job Stress" OR "Work Stress")* and the limits *Journal Article; English; Humans; Treatment Outcome/Clinical Trial*. Selection on title gave nine articles, which was reduced to four articles from the abstracts.

Searching the Cochrane Central Register of Controlled Trials yielded 828 potential candidates, using the MeSH term *Stress* and searching *Clinical Trials* only. From the titles four papers were identified, which was reduced to one article after reading the abstracts.

The articles identified in the searches of PubMed, PsycINFO and the Cochrane Library came to a total of 27 articles, after removing duplicate entries.

Through monthly e-mail updates on the search performed in the PubMed database, one more study, published in 2008, has been found.

Evaluation of the identified studies

The identified papers were read in full text and evaluated in terms of a set of criteria, that would allow for comparison to the results from the MARS study.

Six criteria were set to identify studies that would be optimally comparable to the MARS study; the studies should 1) be randomized controlled trials, 2) recruits participants from the general population, 3) have inclusion based on symptoms severity or a pre-specified condition (i.e. sick leave), 4) deliver the intervention in a group format, 5) build on the treatment rationale of cognitive behaviour therapy, and 6) have a volume of 5 or more contacts or sessions.

Among the 27 studies identified in the literature search, no study was found that fulfilled all six criteria for optimum comparability.

However, a number of studies fulfilled three of the original six criteria, in that they were randomized controlled trials investigating the efficacy of interventions based on cognitive behaviour therapy, with at least 5 contacts or sessions. These studies share enough similarities with the MARS study, to allow for a comparison of the results, in spite of the inter-study differences. They differ from the MARS study in varying degrees in terms of the study population, whether there was selection on symptom severity, and if a group format was used as the intervention format. See Table 3.2 (p. 23) for a schematic presentation of the seven studies that have been found most comparable to MARS.

In terms of comparable studies that focus on psychological outcomes, three studies stand out in relation to MARS. One study by Gardner et al. [49] uses a wait-list control design to investigate the effect of a stress management training program on health care professionals, but includes participants both with and without elevated stress. Another study by Nickel et al. [50] uses a randomized design with a placebo control condition, but is limited to include only men. A third study by de Jong & Emmelkamp [51] uses a randomized controlled design, but recruits participants through an employing organization.

Focusing on physiological outcomes, the study by Nickel et.al. [50] is relevant in this context as well, alongside the study by McCraty et.al. [52].

When looking at absenteeism from work as an outcome, there is a string of dutch studies that have used both self-reported and register-based assessment of absen-

Table 3.2: Comparable randomized controlled trials of stress management interventions.

Author (year) (Country)	*n*	Intervention(s)	Control condition	Gender (F / M %)	Occupations	Selection on severity	Volume, Time frame	Follow-up (months)	Outcomes	Effect
Willert (2009)(DK)	102	Group CBT	Wait-list (3 months)	82 / 18 %	No selection	Yes	24 hours, 3 months	0–3,6,9,(18)	Psychological Physiological Absenteeism	+ – +
Vente (2008)(NL)	82	Individual / group CBT	Care-as-usual (OP and GP)	39 / 61 %	No selection	Yes	12/24 hours, 4 months	0–4–7–10	Psychological Absenteeism	– –
Nickel (2007)(AU)	72	Group CBT	Placebo intervention	0 / 100 %	No selection	Yes	24 hours, 2 months	0–2	Physiological Psychological	+ +
Blonk (2006)(NL)	122	Individual CBT (2 kinds)	Care-as-usual (GP check-up)	19 / 81 %	Self-employed	Yes	5-11 sessions, 6 months	0–12 0–4–10	Absenteeism Psychological	+ –
Gardner (2005)(UK)	138	Group CBT and BT	Wait-list (3 months)	82 / 18 %	Hospital workers	No	10.5 hours, 1 month	0–1–3	Psychological	+/–
Klink (2003)(NL)	192	Individual CBT	Care-as-usual	37 / 63 %	Postal workers	Yes	5+ sessions, Up to 1 year	0–3–12	Psychological Absenteeism	– +
McCraty (2003)(USA)	38	Group-based workshops	Wait-list (3 months)	28 / 72 %	Telecompany workers	Yes	16 hours, 2 weeks	0–3	Physiological Psychological	+ +
Jong (2000)(NL)	155	Group CBT	Assessment-only	53 / 47 %	Police, school and hospital workers	Yes	20 hours, 2 months	0–2–6	Psychological	+

teeism and return to work [53, 54, 55, 56, 57, 58]. Three of these studies offer results that are particularly relevant in comparison with the results from MARS, namely the studies by de Vente et.al. [54], van der Klink et.al. [55] and Blonk et.al. [53]. The findings from these studies are contrasted to the findings from the MARS study in the discussion section of this thesis.

The above identified studies, relating to psychological, physiological and social endpoints, are not commented further upon in this section. Each is described in further detail in the original papers I–IV, and their relevance and comparability to the findings from the MARS study are evaluated in the discussion sections of the original papers.

4 Aims of the thesis

The aims of the thesis are to investigate the effects of a group-based, cognitive behavioural stress management intervention directed at workers with elevated symptoms of work-related stress.

The investigation is performed within the context of a biopsychosocial framework for the understanding work-related stress. More specifically the thesis investigates the effects of the intervention on:

Psychological outcomes:

- Changes in perceived stress and coping strategies – Paper I
- Effects on self-reported sleep and cognition – Paper II

Biological outcomes:

- Changes in adrenergic, catabolic, and metabolic processes – Paper III

Social outcomes:

- Changes in absenteeism from work and rate of return to work – Paper IV

5 Population sample and methods

5.1 Study design

The study used a randomized, wait-list controlled design. The participants' progress through the phases of the trial are outlined in a flowchart (see Figure 5.1, p. 28).

Wait-list versus no-treatment control design

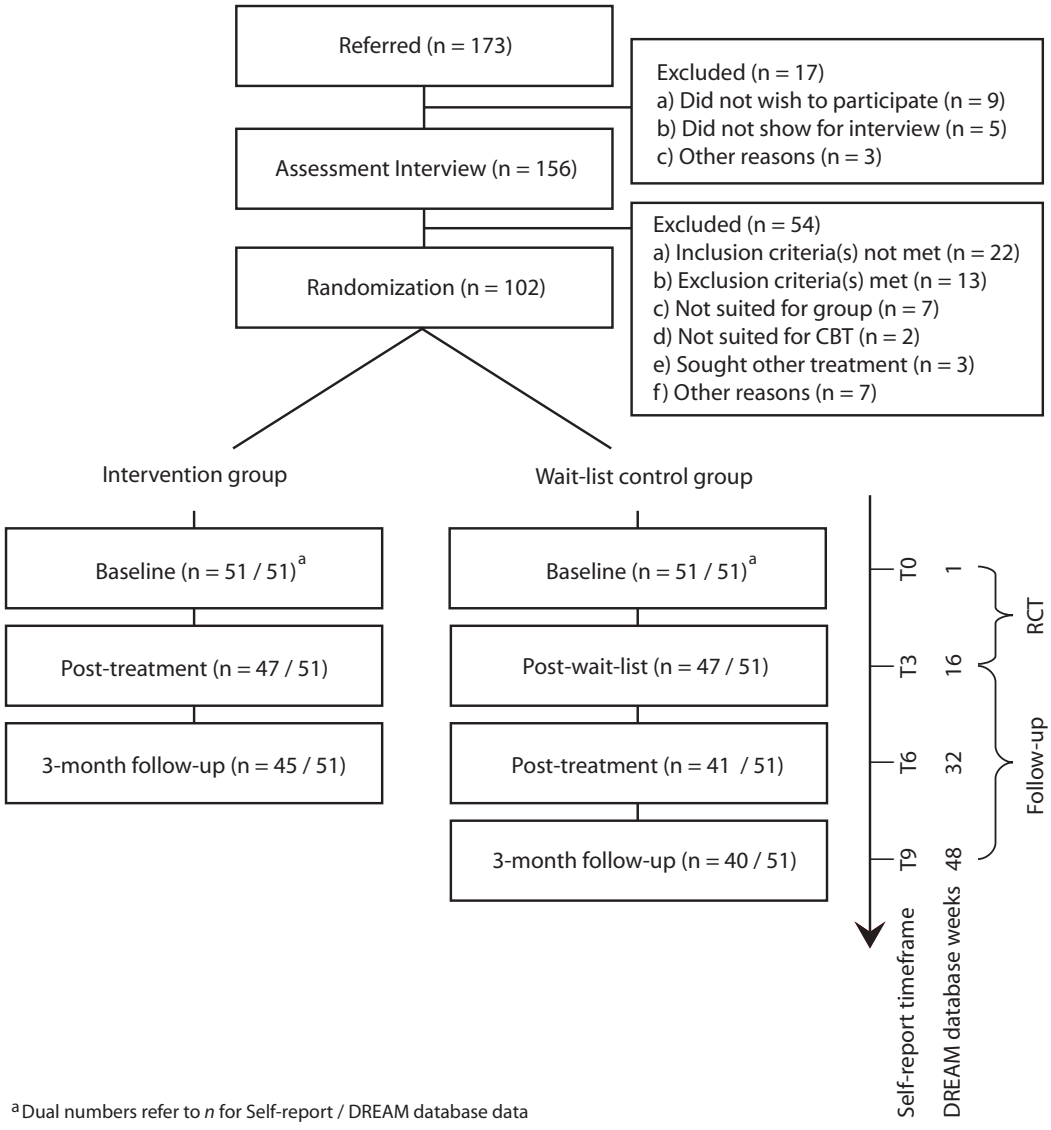
Using a wait-list controlled study design, rather than the conventional no-treatment control design, was based on a number of considerations. A conventional control design works well with laboratory animals, but has some limitations when performing research on human participants, both in terms of ethical and methodological issues.

When enrolling people that are suffering emotionally in a research project, offering no help may seem like a tough condition to impose on people that may be seeking help in lack of other alternatives. One may discuss whether such a condition is in line with the epidemiological research guidelines of "Do only good, do no harm" as put forth by the International Epidemiology Association in the Good Epidemiological Practice Guidelines [59].

A practical consideration favouring the wait-list control design is that persons in a no-treatment control group may have low motivation to stay in the project throughout the follow-up period, since they do not benefit from staying after their randomization. This could lead to asymmetrical drop-out rates between the intervention and control groups. Also, if staying for follow-up measurements, no-treatment controls may be prone to seek help elsewhere, as stress management interventions on the private counseling market are proliferating. This would induce an amount of noise to the data for the control group, as we would not know the nature of the treatment received elsewhere, nor the possible effect it may have on the course of recovery for the control group.

In research on the effects of psychological interventions, the wait-list controlled design is a commonly used design. In the context of evaluating stress management interventions it has been employed successfully in two of the studies [52, 49] identified in the literature review performed in relation to the MARS project outlined i

Figure 5.1: Flowchart of participants' progress through the phases of the trial.



[a] Dual numbers refer to *n* for Self-report / DREAM database data

Chapter 3.

5.2 Sample size

A sample size of 90 was needed to detect a between-groups difference of one standard deviation on the Perceived Stress Scale, 10-item version (range 0–40 points, standard deviation (SD)=5 points) [60]. The estimate is based on: significance level=95%, power=80%, SD=5 points, intra-class correlation coefficient=0.15, average cluster size=9. To allow for a 10% dropout from the study in the first phase of the trial a total of 102 participants were included.

5.3 Randomization

After their baseline measurement participants were randomized to either the Intervention (I) group or to a Wait-list control (WLC) group.

Randomization was performed as a block randomization, in blocks of 6, using the RANNOR computer algorithm. The randomization was performed by an external consultant, and placed in sealed envelopes handled by the project secretary. Participants from the Intervention and the Wait-list control condition were mixed when forming new groups, to minimize differences (intra-class correlation) between treatment groups.

5.4 Baseline and follow-up measurements

Questionnaire- and laboratory-based outcome variables were measured at baseline and at 3-, 6- and 9-months follow-up, whereas the register-based outcome variables were obtained from baseline and 52 weeks onwards.

5.5 Referral and time frame

Participants came from the working population (18-67 years) in the municipality of Aarhus and its surrounding communities. Referral was available for local GP's, union

social workers, and through direct inquiry. All potential participants were assessed by a physician, either by their GP prior to referral or by a resident occupational physician. Advertisement for the project was done through letters sent to local GP's, meetings with union social workers, a website, and advertisements in a door-to-door distributed local newspaper.

A total of 173 persons were referred to participate, as illustrated in the flowchart (Figure 5.1, p. 28). Out of this initial number 156 persons were invited to an assessment interview to determine eligibility, while 17 potential participants were excluded on grounds of either not wishing to participate after receiving information about the study (n=9), not showing up for the assessment interview (n=5), or other reasons not classifiable in a joint group (n=3). On grounds of the assessment interview 102 persons were invited and accepted to participate, while 54 persons could not be included. Reasons for exclusion at this stage was based on not meeting the required inclusion criteria (n=22); meeting one or more exclusion criteria (n=13); assessed as not suited for treatment in a group setting (n=7) or not suited for treatment with cognitive behaviour therapy as delivered in the study (n=2); having sought other treatment while waiting for the assessment interview (n=3); and other reasons not classifiable in a joint group(n=7). All persons that could not be included were given advice on other alternatives.

Referral, inclusion and randomization was performed over a period of 10 months from December 2006 through September 2007, with groups running in succession from January to December 2007.

5.6 Conceptualization of stress in the MARS study

In the MARS study we considered carefully how to conceptualize and define stress, using both earlier theories and current knowledge of the concept in relation to work, as well considering the context of occupational medicine and psychology in which the study was situated.

From the previously outlined lack of strong epidemiological evidence supporting a mono-causal relationship between work characteristics and psychological well-being and health (section 2.2), we decided not to define stress as a causal effect

of specific work characteristics (i.e. demand-control-support or effort-reward imbalance), but chose the term *work-related* as a prefix to stress, to emphasize that the individuals' working environment was assessed as being *part* of the individuals' current inability to cope with work, for example through reactivity of symptoms to demands at work, without assuming work to be the sole *cause* of the participants' situation.

The relatedness-to-work of the participants' problems was hypothesized as having a maintaining function on their current problems. Thus the intervention program under trial was directed at changing participants' ways of coping with their work, and through this process alleviate the participants' symptoms. A parallel to this approach is seen in cognitive behavioural psychotherapy for depression, where the maintaining role of the patients' symptoms are challenged in the treatment, without necessarily dealing with the cause of the patients current depressive episode [29].

Working definition of work-related stress

For our working definition of whether a person referred to the project had work-related stress or not, we chose a three-prong strategy. The two first criteria reflect an attempt to use criteria of a more objective nature that would be assessed alike between referred potential participants, regardless of the course of the assessment interview. The last criteria relied on information obtained in the assessment interview, and would differ between persons interviewed.

Participants were required to fulfill at least one of the two first criteria, while fulfillment of the third criteria was always required.

The first criterion regarded referred potential *participants that were currently active at their work place*. For this group we looked at whether they scored above a cut-off on a scale measuring perceived stress. The cut-off was set at one standard deviation above a population sample mean. One could argue that this is an arbitrary cut-off point. However, in psychotherapy research the criterion of being within one standard deviation of a normal population sample mean, has been used to determined whether a treated person may be considered rehabilitated [61]. In this case, we reversed this definition of normality, to determine whether potential participants could be considered as being *outside* of the normal range.

The second criterion was for referred potential *participants that were on sick leave at the time of referral*. This group was defined as being outside of the normal range by virtue of being on sick leave sanctioned by their general practitioner (GP). However, since the rationale of the intervention relied on the interplay between skills learned in the group and home work assignments of practicing those skills at the work place, those on sick leave at the time of referral were required to have a planned return to activities at their work place within four weeks from the assessment interview.

The third criterion was the *presence of perceived stressors in the work place in the past six months*. This could be in the form of increased work load, organizational changes, role conflicts, lack of support, etc. This criterion was included to ensure that the individuals current problems were work-related, even though this assessment was not without risk of bias, since it relied on the participants' subjective retrospective recollection of events at work that may be coloured by their current troubled state at the time of referral. However, we did find it better to include this criterion, than to leave it out all together.

The assessment procedure to determine potential participants' eligibility for participation, as well as a full list of in- and exclusion criteria are described in more detail in the following sections.

5.7 Eligibility

Inclusion criteria were persistent symptoms of work-related stress, defined as physiological and psychological symptoms of sustained arousal lasting more than 4 weeks and elevated reactivity of symptoms to demands at work. Another criteria was a time sequence where, within the last 6 months, major organizational or other changes at work (i.e. increased case-load, long-term sick leave among colleagues, no temps available to fill in, etc.) preceded the stress reaction. Motivation to remain employed and planned return to work within 4 weeks, if on sick leave, was required. Participants were either on sick leave through assessment by their GP, or active at their workplace. For the latter, a score of 20 points or above (one SD above the population mean reported by Cohen [60]) on the Perceived Stress Scale was required.

Exclusion criteria were being on sick leave for more than 26 consecutive weeks;

having substantial psycho-social strains outside of work; bullying as the main problem; severe psychiatric condition or a history of repeated psychiatric conditions, and current abuse of alcohol or psychoactive stimulants.

When determining caseness for work-related stress it was not possible to determine back in time whether the cause of the stress experienced by the individual was purely attributable to their work, but work was in all cases assessed to be a contributing factor in sustaining the participants' present condition.

5.8 Assessment

All potential participants were given an assessment interview by a clinical psychologist (>5 years training). The assessment interview followed a semi-structured format covering the criteria for participation outlined above and a structured form was filled out by the interviewer during every interview.

The content of the Assessment Interview covered the following topics: current work status (at work, partial/full sick leave); duration of sick leave and expected return to work; account of events at work leading to current situation; physiological and psychological symptoms of stress, family/social life, personality traits; duration of contact to GP, current medication, history of previous psychiatric treatment, current use of alcohol or psychoactive stimulants.

In addition to the interview four questionnaires (Perceived Stress Scale [60], Life Events [62], Nordic Basic Sleep Questionnaire [63] and Outcome Rating Scale [64]) were used when assessing eligibility.

5.9 Allocation and dropout

Upon completing the baseline measurement an envelope containing the participants allocation was opened by an independent person. After randomization a total of 51 participants comprised the wait-list control group, while 51 participants made up the intervention group.

In the first three months after baseline overall participant dropout was four from the Intervention group and four from the Wait-List Control group (see Figure 2.1,

p. 11). Depending on the outcome one investigates the number of dropouts varies slightly, as can be seen by comparing the flowcharts from Papers I-IV. This is due to the multiple sources of data the study relies on, e.g. one participant may have filled out his questionnaire at three months follow-up, but fails to show for his appointment in the laboratory, or vice versa.

No systematic differences were found regarding characteristics of participants that dropped out of the study. A more detailed account of dropout rates and reasons for dropping out throughout the study are given in the flowchart of Paper II.

5.10 The MARS intervention protocol

The intervention protocol encompassed 8 three-hour sessions for each group of nine participants. All groups were led by one of two clinical psychologists involved in the project. Groups met for weekly sessions the first 4 weeks, and then every fortnight for the remaining four sessions, spanning a course of three months all together.

The slide show that was used in the group sessions—which forms the backbone of the intervention protocol—may be downloaded as a PDF-file from the project's website at http://www.arbejdsstress.dk/forfagfolk.htm or by contacting the author of this thesis (morten.willert@aarhus.rm.dk).

The MARS intervention protocol relates to the cognitive behavioural model of work-related stress presented in the Background chapter (see Fig. 2.1, p. 11) with respect to the three feedback loops described in the model.

Methods aimed at observation of processes within the cognitive diamond and increasing self-regulation of these processes (feedback loop 1 in the model) are introduced in sessions 2–4. Alternative ways of communication and behaviour at the work place (feedback loop 2 in the model) are explored through the home work assignments between group sessions and in the communication skills training employed in session 6. Intermediate beliefs (feedback loop 3 in the model) are formulated (based on identification and analysis of prototypical situations in the previous sessions), and alternative formulations of dominant intermediate beliefs are introduced.

Session 1 serves as an introduction to the course as a whole and to the rationale behind the intervention program, while sessions 7–8 aim at consolidating what par-

ticipants' have been working on in the previous sessions and establishing relevant strategies for relapse prevention.

Session-by-session summary

In the summary below the MARS intervention protocol is described in more detail than space would allow for in the four original papers included in this PhD thesis. The agenda for each three hour session is presented, along with short descriptions of the psychoeducation themes, techniques introduced, group work themes, role plays, and homework assignments that group members took part in.

Session 1: Introduction	
Welcome	A short introduction to the course and the rationale behind the intervention: "to enable participants to respond in more rational, flexible and constructive ways to stressors at work, achieved through exploration and modification of automatic thoughts and behaviour patterns"
Presentation	Short presentation by each participant (name, occupation, history of work-related stress, reasons for participating)
Psychoeducation	Acute and chronic stress reactions; stressors at work; physiological and psychological symptoms; course of symptomatology; the circular system of thoughts, feelings, bodily sensations, and behaviour; ways of breaking the cycle
Homework	Registration of critical situations: situation, symptoms, scale 0–10; list of personal goals to work on in the course
Mindfulness	Short *Breathing space* exercise
Session 2: Cognitive Therapy and Personal goals	
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework

Psychoeducation	A Cognitive Behavioural model of stress
Group work	Personal goals, followed by discussion in plenum
Homework	Continued registration of critical situations: situation, symptoms, thoughts and feelings, scale 0–10
	Session 3: Identifying Dysfunctional Thinking
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework
Psychoeducation	Sleep and sleep hygiene following Bootzin's [65] Negative automatic thinking and thought patterns
Group work	Symptoms and thoughts associated with stressful situations
Technique	Using column-technique to challenge automatic thinking
Homework	Continued registration of stressful situations; use column-technique to analyze and modify thoughts and behaviour
	Session 4: Setting priorities and Intermediate beliefs
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework
Group work	Using 5-column technique
Psychoeducation	Setting priorities
Psychoeducation	Intermediate beliefs in a cognitive framework
Homework	What are my Intermediate beliefs? – and what are the consequences of following these beliefs?
	Session 5: Working with Intermediate beliefs
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework

Psychoeducation	How to understand – and challenge – Intermediate beliefs
Group work	Challenging my Intermediate beliefs
Homework	Continue identifying and challenging Intermediate beliefs

Session 6: Communication skills	
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework
Group work	Status on progress and barriers; revising personal goals
Psychoeducation	How thoughts about, or during, communication may restrict my range of possible actions; Assertive communication skills
Role play	A critical situation with focus on communication, from one of the participants' work life, is role played. The participant plays herself, the group leader plays the co-worker/manager/?, while the rest of the group act as a reflecting team, helping the participant refine his/her communication skills through several rehearsals of the same situation
Homework	Identify and analyze critical situations in communication – What are my options and what will I try next time?

Session 7: Current stressors at work	
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework
Group work	What are my current stressors at work – and what can I do about them?
Homework	Individual homework based on personal goals and preferences

Session 8: Review of techniques and Relapse prevention	
Mindfulness	Short *Breathing space* exercise
Round	Feedback on homework

Group work	How do I maintain lessons learned in the group on my own?
Psychoeducation	Relapse prevention and strategies; Steps taken while in group are the first steps of a longer road to recovery; Realistic expectations of future strengths and vulnerabilities
Evaluation	Evaluation of the stress management course; Saying goodbye

5.11 Outcome Measures

The outcome measures of the MARS project fall in three parts: Psychological outcomes (Questionnaire data and laboratory test); Biological outcomes (Blood samples and laboratory tests); and Social outcomes (Questionnaire and register-based data). In the following sections a short overview of each group of outcomes is presented.

Psychological outcomes

Data on psychological outcomes came from the questionnaires filled out by the participants at baseline and follow-up measurements, and one short neuropsychological test measured in the laboratory.

The main psychological outcomes were perceived stress and coping strategies. To measure these we used the Perceived Stress Scale, 10-item version [60] and selected dimensions from the Brief COPE questionnaire [66]. Both questionnaires and their psychometric properties are described in detail in Paper I.

Secondary psychological outcomes were quality of sleep and cognitive ability. These outcomes were chosen since they reflect two categories of symptoms that are frequently reported, and are often associated with much concern by patients with regard to their ability to perform at work. To measure sleep and cognition we relied on questionnaire-based measures of self-reported quality of sleep and amount of hours spent in bed (Basic Nordic Sleep Questionnaire [63]), amount of everyday cognitive failures (Cognitive Failures Questionnaire [67]), and—from the laboratory tests—the

Digit Span test (from the WAIS III-R battery of intelligence tests [68]). All measures and their psychometric properties are reported in more detail in Paper II

Biological outcomes

Data on biological outcomes are derived from blood samples and tests taken in the laboratory at the Department of Occupational Medicine, Aarhus University Hospital, at the baseline measurement and all follow-up measurements.

From the physical examination in the laboratory blood pressure and resting pulse were measured, to asses adrenergic processes.

Blood samples were analyzed with regards to catabolic processes by measuring levels of cortisol. Metabolic processes were assessed by measuring the levels of triglycerid and cholesterol (including low-density lipo-protein associated cholesterol (LDL) and high-density lipo-protein associated cholesterol (HDL). Analysis of circulating levels of glucose in the bloodstream was assessed by measuring Haemoglobin A_{1C} levels. Thyroid function was evaluated by analysis of the hormone thyreotropin.

Further description of the biological outcomes are provided in Paper III.

Social outcomes

In the study absenteeism from work was the primary social outcome. In accordance with the recommendations of Pole [17] we used two independent measures of absenteeism from work. One measure was a self-reported questionnaire, the other consisted of data from a national database of public transfer payments.

For the self-report measure participants were asked to report on their amount of days on full or partial sick leave in the preceding three months, at each follow-up measurements after baseline.

Register-based data of long-term absenteeism from work was obtained from the DREAM database, which is a national database of public transfer payments. The database contains registrations on a week-by-week basis of danish citizens receiving any form of transfer payment, including sickness compensation benefits claimed by their employer. Data on registrations in the DREAM database were obtained from each participants' date of randomization and 52 weeks ahead, as well as back, in time.

Further details of the social outcome measures are given in Paper IV.

5.12 Statistical Analyses

Statistical analyses were performed using the STATA (Stata Corp LP, College Station, TX, USA) and WinPEPI (Brixton Health, London, United Kingdom) software packages.

Baseline characteristics were compared using the chi-squared test of comparable distributions and the student's t-test.

Outcome analyses for the psychological, biological and social outcomes were performed using a range of different statistical models, depending on the properties of the data in each outcome category. The analysis methods used are outlined below. All statistical methods are described in further detail in the corresponding original papers.

Analyses of psychological outcomes – Papers I and II

For the psychological outcomes analyses were performed as intention-to-treat with a mixed-model univariate repeated measures analysis of variance.

The data for both the primary and secondary psychological outcome measures were analyzed blinded, by letting an external consultant recode the grouping variable. The blinding was kept unbroken until final conclusions had been drawn on the results.

Model validation was performed using Bland-Altman plots, QQ-plots of the residuals and sum-residual plots. To enable comparison between the different measures, effect sizes were calculated using Cohen's d [48].

Analyses of biological outcomes – Paper III

For the biological data outcome analyses were performed with the student's t-test. Model validation was performed using histograms, QQ-plots and box-and-whiskers plots, and by testing for comparable variances in the two groups (variance-ratio test).

Analyses of social outcomes – Paper IV

The social outcome data were analyzed with the Mann-Whitney U-test, since both the self-reported and register-based data were highly skewed, depicting a distinct U-shape when presented in a histogram.

Calculation of Somer's *D* was used to estimate the percentual difference in sick leave registrations. Calculating Somer's *D* is a method used to estimate percentual differences in scores between randomly chosen pairs of subjects from two groups, or conditions, in non-normally distributed data [69]. In the present context it describes the percentual difference in sick leave between a randomly chosen participant in the Intervention group compared to a randomly chosen participant from the Wait-list control group.

Survival analysis of the register-based DREAM data was performed by Kaplan-Meier plot and Cox regression analysis. Model validation of the proportional hazards assumption was performed by visual inspection of a log-log plot of the survival curves and by the proportional hazards test.

Comparing effects of different interventions

A common method to compare results across intervention studies is to calculate the *effect size*, or *standardized mean difference*, of observed changes in outcomes. An effect size indicates the magnitude of an observed effect in a standard unit of measurement (e.g., a standard deviation), which is independent of the unit the original outcome is measured in. Effect sizes are denoted using Cohen's *d*.

Calculating Cohen's *d* involves recalculating changes over time from the original scale measure unit (i.e. scale points or mm Hg) to changes over time expressed in terms of standard deviations (SD) from the original distribution at baseline, and is calculated as

$$d = \frac{\textit{mean change over time in group A} \; - \; \textit{mean change over time in group B}}{\textit{pooled variance (SD) of groups A and B at baseline}}$$

Effect sizes have been categorized along a continuum of no effect (d<0.2), low (d=0.2–0.5), medium (d=0.5–0.8) and high (d>0.8) [48].

In an uncontrolled study design effect sizes are calculated as within-group changes from the pre- to post-intervention measurement. This is labeled an *uncontrolled effect size*. In a controlled study design, comparing an intervention to a control condition, the effect size is calculated as the between-groups difference of the within-group changes in the intervention and control groups. This is referred to as a *controlled effect size*.

6 Results

In the sections below the main findings from the MARS study are presented. Additional results in the form of figures, tables and explanatory text can be found in the original papers I–IV.

6.1 Baseline characteristics

The participants baseline characteristics are outlined in Table 1 in each of the four original papers. No statistically significant differences were observed between the Intervention and Wait-list control groups at baseline. In the following paragraph a few comments are made on the overall characteristics of the participants.

Four out of five participants were women, and three out of four were above 40 years of age. All though there were no restrictions on occupation, three out of four participants came from the social, health care, teaching and administration sectors. Three out of five participants were on full or partial sick leave at baseline. One out of four participants used anti-depressive medication. All but three participants had contacted their general practitioner (GP) prior to inclusion, though not all participants were referred via their GP.

6.2 Perceived stress and coping – Paper I

For our first results we looked at changes in perceived stress and five coping dimensions (Emotional Support, Instrumental Support, Active Coping, Planning and Positive Reframing).

On these outcomes we looked at whether there is a difference between the intervention and the wait-list condition in the first three-month phase of the trial. After the post-intervention / post-wait-list measurement at three months after baseline, the two groups are no longer comparable in a controlled design . As a consequence each is group is followed separately in the remaining part of the trial, from three to nine months. For a graphical presentation of this distinction in the study design, see the right-hand side time line in the flowchart (Fig. 5.1, p. 28).

Perceived stress

On the Perceived Stress Scale (PSS-10), in the first three-month phase of the trial, we found a within-group (or *uncontrolled*) effect size of d=1.11[0.80;1.42] in the Intervention group, while the Wait-list control group showed a within-group effect size of d=0.19[-0.12;0.51]. When comparing the intervention to the control condition in this first three-month phase of the trial, we found a between-groups (or *controlled*) effect size favouring the intervention of d=0.92[0.48;1.36].

When followed up three months after termination of treatment the Intervention group maintained the gains achieved. After their stay on the wait-list the Wait-list control group received the intervention as well, showing an within-group effect size of d=0.69[0.36;1.02]; these gains were also maintained at follow-up three months after termination of treatment.

Coping dimensions

On the five coping dimensions investigated; Emotional Support, Instrumental Support, Active Coping, Planning and Positive Reframing, only the dimension Positive Reframing differed between the intervention and wait-list control conditions. In the same fashion as for the results on perceived stress, we found an controlled effect size favouring the intervention of d=0.49[0.08;0.90] in the first three-month phase of the trial.

In the Intervention group the gains achieved at post-intervention were maintained at three months follow-up. When the wait-list control group receives the intervention a within-group effect size of d=0.32[0.01;0.63] is found; these gains were also maintained at three months follow-up.

Supplementary analyses

Not presented in Paper I are two supplementary analyses that have been performed to analyze different subgroups in the Intervention and Wait-list control groups.

For our presentation of the main findings in Paper I, we were reluctant to do these kinds of analyses, since it introduces groups other than those produced by the randomization, compromising the design of the randomized controlled trial [70]. How-

ever, to highlight the between-subjects variation that may be obscured by the comparison of group means and effects sizes, we find that such supplementary analyses may shed light on important characteristics of the study, for example by highlighting the proportion of participants that were not helped by the intervention.

Two supplementary analyses have been performed, one focusing on the impact of extra-study factors (in the form of seeking help outside of the study), and the other on the percentage of participants that improved while in treatment, also labeled the *response rate* [71].

Supplementary analysis I: Seeing a psychologist outside of the study.

At all follow-up measurements participants would provide information on whether or not they, in the time since their last measurement, had sought other help by seeing a psychologist outside of the study, while enrolled in the trial. We would expect the participants in the wait-list control condition to be more prone to do this, and we wanted to investigate whether or not this may have an influence on the changes found while on the wait-list.

We found that 14 participants in the Wait-list control group had seen a psychologist outside of the study, while being on the wait-list. To our surprise we also found, that 13 of the participants in the Intervention group had done the same while in treatment.

We then looked at changes within each group, from baseline to three-months follow-up. In the Wait-list control group the 14 participants seeking extra-study help improved their mean PSS-10 score with 3.1 points, compared to the 32 participants not seeking extra-study help who maintained almost status quo with an 0.1 point improvement. This difference was not significant (p=0.12, using the student's t-test), although this may also reflect the smaller number of participants in each group.

In the Intervention group we also looked at differences between those who did and did not seek extra-study psychological help. The 13 participants who reported having seen a psychologist outside of the study while in treatment, showed a mean improvement on the PSS-10 of 3.5 points, compared to an improvement of those who only received psychological treatment in the group of 7.4 points. This difference was not significant (p=0.07, using the student's t-test), however, this may be due to the

comparison of small groups.

Supplementary analysis II: Percentage of participants improved.

Another way of looking at whether or not an intervention works, besides looking at controlled effect sizes, is to assess the number of participants that have improved from their baseline level when followed up after treatment, also labeled the *response rate*.

Looking at the response rate in the MARS study, we found that 37 (72%) of the participants in the Intervention group showed an improved score on the PSS-10 at post-treatment follow-up compared to their baseline score (range: 1–20 points improved, mean: 6.9 points). On the other hand 9 (18%) participants showed no change or a worsened score on the PSS-10 (range: 0–15 points, mean: 3.7 points worse), indicating that participation in the intervention may not have been benificial to them.

6.3 Sleep and cognitive ability – Paper II

For our secondary psychological outcome analyses we looked at quality of sleep and cognitive ability, especially memory functions. These are areas that participants with work-related stress often experience as impaired, and which often cause worries and concerns about future ability to work.

On quality of sleep, measured using the Basic Nordic Sleep Questionnaire [63], both groups show significant within-group changes over time. Looking at the difference between the amount of change in the two groups a significant controlled effect size of d=0.64[0.24;1.05] was found.

On cognitive ability, measured using the Cognitive Failures Questionnaire [67], we found a significant within-group change in the Intervention group that is roughly 5 times greater than the changes in the Wait-list control group. Looking at the difference between the amount of change in the two groups a significant between-groups effect size of d=0.57[0.24;0.90] was found.

As with the measures of perceived stress and positive reframing, gains achieved on quality of sleep and cognitive failures were maintained at three months follow-up,

and the effect of the intervention was mimicked in the Wait-list control group, when they received the intervention after their stay on the wait-list.

Regarding hours spent in bed and the Digit Span Test [68] no significant within- or between-groups results were found.

6.4 Biological markers of stress – Paper III

On the biological markers, which included blood pressure and resting pulse; levels of cortisol, triglycerid and cholesterol (Total, LDL, and HDL), Haemoglobin A_{1C}, and thyreotropin, the Intervention and Wait-list control groups were comparable at baseline and levels of biomarkers were within clinical and laboratory reference levels.

In the following paragraphs baseline levels and changes in blood pressure and cortisol will be highlighted.

At baseline an average blood pressure of 118/76 mm Hg for the Intervention group, and 120/78 mm Hg for the Wait-list control group, was found. From baseline to the three months follow-up measurement both groups exhibited a drop in systolic and diastolic blood pressure (Intervention: Sys: -2.73 mm Hg/Dia: -1.42 mm Hg; Wait-list control: Sys: -3.60 mm Hg/Dia: -1.71 mm Hg). When comparing the changes in the two groups over time, no differences were found between the intervention and wait-list control conditions (Sys: p=0.72/Dia: p=0.88).

Mean levels of cortisol did not differ between the two groups at baseline (Intervention: 497.20 nmol/l; Wait-list control: 503.79 nmol/l). From baseline to three months follow-up the mean cortisol level dropped 23.80 nmol/l for the Intervention group (p=0.23), while it dropped 42.88 nmol/l for the Wait-list control group (p=0.03). When comparing the changes in the two group over time, no significant differences were found (p=0.49).

In paper III baseline levels and changes over time for all the biological markers investigated are presented.

Overall, for the entire array of biological markers of stress no systematic within-group differences were found on changes from baseline to three months follow-up (p=0.01–0.93). No between-group differences were found when comparing the changes over time in the two groups (p=0.17–0.93).

6.5 Absenteeism and return to work – Paper IV

Absenteeism was assessed through both self-reported and register-based data; return to work was measured using register-based data only.

After the intervention or a stay on the wait-list, self-reported absenteeism in the Intervention group (median: 11[3-25] days) was lower (p=0.02) than in the Wait-list control group (median: 45[19-60] days). Using *Somer's D* a 29[5-52]% reduction of reported days on sick leave was found.

From the register-based data on sick leave registrations in the DREAM database in weeks 1–16, the Intervention group median (6[0–11] weeks) was lower than the Wait-list control group median (12[8–16] weeks), though not reaching statistical significance (p=0.06). Calculating Somer's D this corresponds to a 21[0-42]% reduction.

For the 60 participants with a DREAM database registration of sick leave at randomization, the median week of return to work was week 16[11–26] in the Intervention group, compared to week 33[14–43] in the Wait-list control group. This difference translates into a Hazard Ratio (of returning to work) of HR=1.58[0.89-2.81] favouring the intervention group, but not reaching statistical significance (p=0.12).

7 Discussion

7.1 Main findings from the MARS study

In the following three sections the main findings from the MARS study are summarized and discussed in the context of results found in comparable original studies of stress management interventions.

Psychological outcomes

Observed effects

In a randomized wait-list controlled design we found the intervention to be superior to the no-treatment wait-list control condition in reducing perceived stress, strengthening coping in terms of positive reframing, improving experienced quality of sleep, and lowering reported amount of everyday cognitive failures.

The found effects have been translated into standardized mean differences using Cohen's *d*. On perceived stress the effect found may be considered *large*, the effect found on positive reframing may be considered *low*, while the effects on quality of sleep and cognitive failures are of *medium* size.

On all measures with an effect of the intervention superior to the wait-list control condition, follow-up of each group shows that gains achieved during treatment are maintained three months after termination of treatment. Strengthening the results from the first wait-list controlled phase of the trial, the effect of the intervention is replicated for the Wait-list control group, when they are given the opportunity to participate in the intervention, all though with smaller effect sizes observed than those of the Intervention group.

No effect of the intervention was found on measures of four coping dimensions (Emotional Support, Instrumental Support, Active Coping, and Planning), hours spent in bed per night, and a short neuropsychological test of working memory attention span.

Finding evidence of changes on only one out five coping dimensions investigated was contrary to our expectations. In the treatment manual much emphasis was placed

on the coping dimension of work-related stress, in line with the coping theory proposed by Lazarus & Folkman [10]. Changes in perceived stress were hypothetized to be concurrent with changes in coping strategies. However, only one coping strategy changed along with the reduction in perceived stress we found, lending only very limited support to the hypothesis that changes in coping strategies result in less perceived stress.

At the core of cognitive behaviour therapy is the identification and modification of negative automatic thoughts. Observing changes on the coping dimension of Positive Reframing is in line with this rationale. Compared to the cognitive behavioural model for understanding work-related stress (Fig. 2.1, p. 11), finding changes on positive reframing relates to the first feedback loop of the model. This feedback loop concerns self-regulation as a means of regulating the interplay of thoughts, emotions, physiological reactions, and behavioural impulses that occur within the cognitive diamond in the model.

However, we do not find evidence in the four other coping dimensions of the behaviour modifications that are to follow from the modification of thoughts through positive reframing. The four behavioural coping strategies we investigated would relate to the second feedback loop in the cognitive behavioural model for understanding work-related stress (Fig. 2.1, p. 11), which entails interacting with the environment. One understanding of this could be that participants did not get better at using these coping strategies. Another understanding, however, could be that participants were already using these coping strategies, and therefore there would be less room or need to improve following from the intervention on the utilization of these strategies.

Comparison with other studies

When compared to results from similar previous studies, especially the studies by Gardner et al. [49], Nickel et al. [50], de Jong et al. [51] and de Vente et al. [54] identified in the literature review (see Table 3.2, p. 23), the present trial supports the findings that stress management interventions based on cognitive behaviour therapy can lower perceived stress.

No previous studies have been located that investigate the effect of a stress management intervention on sleep and cognition. However, a number of studies have

investigated the connection between stress per se and either sleep or impairment in cognitive ability.

Looking at stress and sleep a strong association has been found between psychosocial strain experienced at work and poor quality of sleep [72, 73, 74]. Following from this, it is proposed that the stress management intervention may lower participants' perceived psycho-social work strain, thereby improving the quality of sleep.

Work stress has been associated with cognitive failures [75, 76]. In a similar fashion to the argument made on stress and sleep, it is proposed that by improving participants' ability to deal with work stress, the amounts of cognitive failures reported are also lowered.

Expanding on what is known from the majority of previous studies, the present trial suggests that a stress management intervention is effective also when applied to a sample recruited from the general population, having symptoms of elevated levels of stress and coming from a wider range of diverse occupations than was included in most previous trials. The results we have found are in accordance with the results from the de Vente et al. study [54], which is the study that compares best to the MARS trial.

Supplementary analyses

From the supplementary analyses performed on changes in perceived stress we may learn two things.

First, extra-study factors, such as seeking psychological help outside of the intervention trial, is reported by a little less than a third of both the Wait-list control *and* the Intervention group participants, and may have an impact on the changes observed in each group. For the Wait-list control group those seeking extra-study psychological help seemed to benefit from it, whereas those in the Intervention group doing the same seemed to benefit less from the intervention, than their co-participants who received psychological help only within the study. No firm conclusions can be drawn from the present data, but the results highlight the potential bias which may occur from extra-study confounders, such as seeking outside help parallel to an intervention under trial.

Secondly, the supplementary analysis of the response rate of patients improved during treatment demonstrates that, all though the Intervention group mean changed positively from pre- to post-intervention, almost one fifth of the group members experienced none or a negative change from their baseline level. An intervention that helps four out of five may be considered successful, but it still raises the question of what we should do regarding those that are apparently not helped by the intervention.

Biological outcomes

On the biological outcomes baseline levels are within clinical and laboratory reference levels. No systematic within-group changes over time for the Intervention and Wait-list control groups were observed. No between-group differences in the changes over time of the two groups were observed on any outcome measure.

The observed mean values on blood pressure at baseline are close to the danish national guidelines for normal blood pressure of 120/80 mm Hg. At the three month follow-up measurement blood pressure has dropped in both groups. These changes may reflect real changes in participants blood pressure, but could also be explained as white-coat, or test-retest effects, which are commonly reported when performing multiple single-point assessments of blood pressure.

Compared to two earlier studies identified in the literature review (see Table 3.2, p. 23), the present results diverge from previous findings.

Nickel et al. [50] found that a group based stress management intervention reduced daily systolic blood pressure and salivary cortisol in a sample of male workers with work-related stress due to overworking. At baseline participants in the Nickel et.al. study had an elevated mean systolic blood pressure of 144 mm Hg.

In the study by McCraty et al. (2003) a reduction in blood pressure among hypertensive employees (72% male) was observed from a shortterm workshop-based stress management intervention. Participants included in the study were hypertensive at baseline, with a mean systolic blood pressure of 129 mm Hg.

In our study population of 80% female workers, with no selection on hypertension, we do not see an effect on blood pressure levels from a group based psychological stress management intervention, as found by previous studies.

Epidemiological evidence [77] suggests that biological markers of stress are associated with work-related stress. However, from our findings we do see a reduction in perceived stress after the intervention, in a population sample with elevated symptoms of work-related stress, but do not see concurrent changes in biological markers of stress.

Social outcomes

Comparing self-reported absenteeism from work between the intervention and the wait-list control condition in the first phase of the trial, a significant 34 days difference in the median number of days absent was found, corresponding to a 5-55% reduction favouring the intervention.

Regarding the participants long-term absence from work in weeks 1-16, a three weeks difference in the median number of weeks registered in the DREAM database was observed, favouring the intervention, corresponding to a 0-40% reduction. However, this difference falls short of reaching statistical significance.

On the rate of a lasting return to work (or equivalent) a tendency in the results favouring an early intervention was found, all though without reaching statistical significance.

Results from earlier studies identified in the literature review (see Table 3.2, p. 23), are diverging with regards to the effect of stress management interventions on absenteeism and return to work.

From a study by de Vente et al. [54], which compares well with the MARS-trial protocol, a trend towards *more* days absent was found, when comparing two stress management interventions based on cognitive therapy with care-as-usual. Contrary to the findings of de Vente et al. the results of the present study suggest that a stress management intervention based on cognitive therapy is effective in lowering self-reported absenteeism.

In a study by Blonk et al. [53], a stress management intervention based on cognitive therapy was not more effective than the no-intervention control group in lowering absenteeism. However, a combined intervention, based on cognitive behaviour therapy, but with the added components of a graded activity scheme guiding the rate of return to work and workplace interventions, surpassed both the control and cognitive

therapy groups. In the present study we find, in contrast to the Blonk et al. study, that a stress management intervention based on cognitive therapy is superior to a wait-list control group.

Lastly a study by Klink et al. [12] compares a graded activity scheme intervention, based on the cognitive behavioural approach *Stress Inoculation Training* [78, 79], with care-as-usual visits to a resident occupational physician. An effect on return to work and absenteeism is found. As in the previous study, the graded activity component is central to the intervention. This component is not explicitly part of the intervention manual in our study.

The three studies that are compared to the results from the MARS study, as outlined above, were all undertaken in Holland. When studying absenteeism and return to work, administrative regulations of the labour market may provide powerful incentives that guide workers' behaviour and actions. As a consequence this may limit the comparability of the present study with studies from other countries, as the dutch labour market is regulated differently from the danish with regards to absenteeism from work. To fully compare the results on absenteeism from the MARS study, we must await the results from several randomized controlled trials of stress management interventions, that are currently being undertaken in a danish context.

7.2 Efficacy of MARS compared to results from meta-analyses

In the previous three sections the MARS intervention has been compared to original studies on both psychological, biological, and social outcomes. In the following section the MARS intervention is compared to what is known from meta-analyses of cognitive behavioural stress management interventions, and from meta-analyses of cognitive behaviour therapy in general.

In the literature review presented in Chapter 3 (see Table 3.1 (p. 19)), three of the identified reviews included meta-analyses on the effect of cognitive behavioural stress management intervention. The results from the MARS study compares well to the pooled effects sizes reported from these meta-analyses.

The effect sizes found in the MARS study on psychological outcomes range from d=0.92 for the main outcome measure of perceived stress, to effect sizes ranging from d=0.49–0.64 for the secondary outcome measures of positive reframing, quality of sleep and everyday cognitive failures. In comparison Richardson & Bryant estimate the effect size of cognitive behavioural stress management interventions to range from d=0.46–1.87 [47], Marine et al. give an estimated range of d=0.49–1.21 [46], while van der Klink et al. report a more narrow estimated range of d=0.54–0.82 [44]).

Compared to the general efficacy of cognitive behavioural interventions the main effect size on perceived stress of d=0.92 is comparable to the mean effect size of d=0.90 reported by Butler et al., in their review of cognitive behavioural interventions for a range of psychological and psychiatric problems.

7.3 Contrasting findings to theories of stress

Compared to the biologically founded theories of stress by Cannon and Selye, we do not find changes in biological markers of stress concurrent with the changes seen on psychological and social outcome measures. This is in contradiction with the biopsychosocial framework for understanding stress, that has been proposed in the background section of this thesis.

On the other hand, the psychological and social outcomes that are measured change as would be expected from our background understanding of work-related stress, with the exception of four coping dimensions. Why do we find the expected changes on psychological and social outcomes, but not on the biological outcomes?

One answer to the above question may be, that the majority of the included participants are outside of what may be considered the normal range at baseline on either a psychological or a social characteristic. Inclusion criteria to the study were defined through either a psychological characteristic (scoring 20 or above on the Perceived Stress Scale) or a social characteristic (being on sick leave).

The baseline levels of biological markers of stress were not extreme, when compared to the available population and laboratory reference levels. In research it is a generally accepted fact, that it is hard to change something that is already normal. This could explain why we see changes on the psychological and social outcomes,

but not on the biological outcomes.

Another explanation may be, however, that we did not measure the biological markers in enough detail; we measured the wrong biomarkers; our sample size was not big enough; etc. It is a characteristic of most studies that have found changes on biological markers of stress, that they employ sophisticated techniques to measure biomarkers repeatedly over time and that stress provocation tests, such as the Trier Social Stress Test [80], are used to elicit bio-physiological stress responses. Also, study populations often include individuals with a more prolonged and severe symptom history, than that of the MARS participants [81, 82]. The MARS study was designed as a clinical field trial, and it was not feasible to include these types of more advanced measurements in the protocol.

As noted in the discussion of the results on psychological outcomes, only very limited support was found for the hypothesis that changes in coping strategies was the driving factor in the effect of the stress management intervention. However, the finding that the coping dimension Positive Reframing changed, may relate to the CATS concept of negative expectancies as a key element in whether or not a given stimulus elicits a stress response in the individual. Enhancing participants' ability to reframe situations in more positive terms, may lead to more positive expectancies of being able to handle a given situation, and thereby less activation of the stress response.

Concerning the Demand-Control-Support and Effort-Reward Imbalance models, the MARS intervention does not address the work environment at the work place directly. However, in the groups participants explore how to react to the demands at work, what they can—and cannot—control at work, who they can turn to for support, how much effort is needed at work, and ways of seeking—or giving themselves—rewards for their work.

By carrying out the homework assignments between group sessions, participants are actively trying to modify their behaviour and attitude towards their work. This may in turn influence the behaviours and attitudes of their co-workers and management at work, hopefully eliciting a positive loop between participants actions and the re-actions of those in their closest work environment. This feedback loop corresponds to the second feedback loop of the cognitive behavioural understanding of

work-related stress presented in Fig. 2.1 (p. 11).

An open question is to which degree the effects that we see from participating in the MARS intervention protocol are derived from the time spent and the lessons learned in the group sessions, and how much is derived from participants' active exposure to their work environment. We like to think that the two elements support each other, so that participants are more likely to cope actively with their work situation through the enhanced control and support tools that the groups provide, and that the benefits gained from the group sessions are elevated by the active utilization at work of the techniques and lessons learned in the groups. However, in the present investigation we—unfortunately—have no data that allow us to tease the individual contribution of these two elements apart.

7.4 Strengths and limitations of the MARS study

Below are outlined some of the overall strengths and limitations of the MARS study. Supplementary discussions of this are found in the original papers I–IV.

One of the strengths of the MARS study is that the randomization procedure successfully split participants in two groups that were comparable at baseline. This minimizes the risk of confounding. The study design, with a three months wait-list, was acceptable to participants; less than one-third sought other psychological treatment while on wait-list. The study sample size, based on a power calculation enabling detection of changes on the PSS-10, was sufficient to detect changes between the intervention and wait-list conditions on both the PSS-10 and other questionnaire measures. Also, there were low rates of dropout from the intervention and wait-list conditions and high participation rates at all measurement points throughout the study; i.e. 88% of participants in the Intervention group, and 78% of participants in the Wait-list control group, deliver some form of data at their three months follow-up after termination of treatment.

Among the limitations of the study are that blinding in randomized controlled trials on human subjects is often limited, or impossible, to achieve. Up to, and including, the baseline measurement the allocation of participants was blind to both

participants and investigators. The randomization of participants to either active treatment or no-treatment control condition was not blind to the participants, or to the laboratory technician handling measurements in the laboratory and collection of questionnaires. To counter the possible bias introduced by the reduced possibility of complete blinding, the data on all psychological outcomes were analyzed blinded by the principal investigator, by letting an external consultant recode the randomization values. This blinding was not broken until the results were analyzed and conclusions regarding the results had been drawn.

With the chosen sample size there was perhaps not enough power for analysis of data on absenteeism. These data were found not to conform to the requirement of analyzing normally distributed data, which was inherent in the power calculations performed with reference to being able to detect a five point difference on the PSS-10 scale.

Also, the wait-list controlled study design may impose an incentive for participants randomized to the initial wait-list condition, to postpone resumption of work until they were to receive the intervention after staying on the wait-list. Thus, we cannot rule out that the effect we find on absenteeism is rather an effect of being put on a wait-list, than an effect of the active intervention ingredients provided by the intervention protocol. However, should this be the case, one may reversely argue that providing an offer of help in the form of a stress management intervention, may provide an incentive to resume work earlier for persons that are on sick leave due to work-related stress.

In the present study design only pre- and post measurements of the intervention protocol were undertaken. This leaves the MARS intervention protocol as what may be labeled a *black box*. We only know what goes in and comes out of the box, but the interplay between the elements of the box, as outlined in the intervention protocol, is unknown to us. In future studies it may be advisable to introduce one or more measurement points between the pre- and post measurements. This would allow for more detailed analyses of which changes precede one another, i.e. do changes in positive reframing occur before changes in perceived stress, or are they concurrent? However, tempting as such analyses may be, they would require a firm theoretical grounding, and would also require a larger sample size, since we would be looking for smaller, gradual differences spread over more time points.

In the present study the efficacy of the MARS stress management intervention is investigated in a very controlled fashion within a clinical research project. However, the effectiveness of the intervention in a routine clinical setting, or with participants from different occupations than those dominating the current trial, is not accounted for. Research has shown that there may be differences between the efficacy of an intervention in a research setting, and the effectiveness of interventions delivered in routine clinical care [83].

The follow-up period of three months after termination of treatment may be considered too short to evaluate long-term effects of an intervention. Since the conclusion of the trial, we have contacted participants 15 months after termination of treatment, and asked them to fill in and return a final set questionnaires. The results from this, along with follow-up on sick leave registrations in the DREAM database, are awaiting further investigation.

A more overall limitation of the MARS study is the focus on a tertiary prevention strategy. Whether or not the results from MARS are evaluated as strong or neglible, one should not neglect the potential benefit of primary and secondary prevention initiatives, that may hopefully lessen the need for tertiary prevention initiatives such as the MARS intervention.

7.5 Relevance of findings from MARS

In a clinical perspective we have found the MARS stress management intervention and the accompanying manual a feasible, effective and resource saving format to offer help to the target group. It is a relatively short program of 8 three hour sessions spanning 3 months, but still substantial enough to initiate changes. Dropout from the groups has been low and verbal feedback from the participants to the group leaders mainly positive.

From a research perspective the present trial extends the scientific knowledge base on the effects of cognitive behavioural stress management interventions. Both the results found on outcomes that changed as a result of the intervention—as well as those that did not change—can be discussed in the light of the findings from other trials, but also put into perspective the different understandings and theories of stress,

and work-related stress, that the study builds on.

It is also important to study the effects of stress management interventions in the context of the danish labour market. Legislation governing the labour market differs between countries, even among countries that we often compare ourselves to, such as Holland, Sweden or Norway. This may limit the comparability on the effects of interventions on outcomes such as absenteeism and return to work.

From a societal perspective it is in everyone's interest to find effective measures against work-related stress, thereby reducing the related economic and human costs.

8 Conclusions

The effects of a group-based, cognitive behavioural stress management intervention have been investigated. The effects were investigated within the context of a biopsychosocial framework for understanding work-related stress.

From the psychological outcomes, a large effect of the intervention has been observed on the main outcome of perceived stress. On secondary outcomes small to medium size effects were found regarding changes in self-reported coping strategies, sleep and cognition . The achieved gains were maintained at follow-up three months after termination of treatment.

On biological outcomes no effects were observed from the intervention. At baseline participants' mean levels on a range of biomarkers were within clinical and laboratory reference levels. No significant effects of the intervention were found.

Regarding social outcomes a reduction in self-reported absenteeism was found in the first phase of the trial. A similar trend was found in the register-based records of long-term absenteeism. No significant effect of the intervention was found on return to work.

9 Perspectives for future research

Theoretical underpinnings

The intervention manual was based on the assumption that improving participant's coping strategies would result in reduced perceived stress. However, only limited support—in the form of improved positive reframing—was found to back up this assumption.

It is recommendable that future research is more firmly based in a more comprehensive theoretical understanding of either stress in general, such as the CATS theory, or work-related stress in particular, perhaps through a refinement of the cognitive behavioural model for understanding work-related stress presented in this thesis (Figure 2.1, p. 11). This would allow for more detailed examinations of whether or not the possible effect of an intervention could be explained within the theoretical framework of the chosen model, for example through statistical methods such as mediation analysis or structural equation modeling.

Methods and measurements

The wait-list controlled research design used in the present investigation has both strengths and limitations. At present there are other investigations of stress management interventions undertaken in Denmark, that employ a no-treatment controlled research design where half of the participants receive no intervention apart from the initial assessment interview. Comparison of the utility and feasibility of this more traditional approach to the current wait-list controlled design, will provide further information regarding the research design of choice for future studies.

The psychological outcome measures used in this study have been found to possess sound psychometric properties and sufficient sensitivity to detect changes over time, and are recommended for inclusion in future studies.

Measurement of biological outcomes should perhaps be done in a more sophisticated manner, e.g. using stress test such as the Trier Social Stress Test and employing more sophisticated measurement techniques. If this proves to labour-intensive to apply to the entire research population, it is perhaps possible to apply it to a randomly chosen subsample of the groups.

Improvements in sleep may be regarded as an important parameter, both physiologically speaking, but also in terms of readiness for work. Further research could include objective measurements of sleep. This could be achieved by measurements via an Actigraph; a small wearable device that monitors sleep rhythms and other physiological variables, or other methods that provide an objective measurement of sleep.

On social outcomes there is a lack of consensus regarding how to measure both self-reported and register-based absenteeism from work in stress management intervention studies. In future research one should be aware that the sample size derived from power calculations based on changes in questionnaire scores, may not be sufficient to measure differences in absenteeism from work, since these rarely conform to a normal distribution of the data.

Extensions of the MARS manual

The MARS manual builds mainly on cognitive behavioural therapy for anxiety and depression, which belongs to what is often labeled the 'second wave' of cognitive therapy. Since formulation of the manual in 2005, the 'third wave' of cognitive therapy has been building momentum [84]. The third wave of cognitive behavioural therapy comprises new developments such as Acceptance and Commitment Therapy (ACT), proposed by Hayes and colleagues [85], Mindfulness-Based Cognitive Therapy for Depression (MBCT), developed by Segal, Williams & Teasdale [86], and the Mindfulness-Based Stress Reduction and Relaxation program (MBSR), developed by Kabat-Zinn and colleagues at the University of Massachusetts Medical Center [87].

It is possible that elements from the third wave programs may be incorporated in the MARS manual. An example of this is the short 'Breathing Space' exercise that is part of every session in the MARS program. An extension to this short exercise could be a more varied set of mindfulness exercises that all participants would receive on a CD or MP3-player. In this way participants could use the guided mindfulness instructions at their own pace between group sessions, if they found it useful. A preliminary recording of a mindfulness exercise has been tested on one of the groups that currently run in the clinic, and was well received by the participants.

10 English summary

Background

Work-related stress has been identified as a major occupational health problem and is related to poor psychological well-being, increased absenteeism from work and losses in productivity.

Interventions that may ease the impact of work-related stress once it has arisen, will be beneficial both to the individual, the employing organization, and society.

Aims

The aims of the thesis are to investigate the effects of a group-based, cognitive behavioural stress management intervention, directed at workers with elevated symptoms of work-related stress.

The investigation is performed within a biopsychosocial framework, where the effects of the intervention are assessed on both psychological, biological and social outcomes.

Population sample and methods

Participants were recruited from the general working population in the eastern part of Region Midt, Denmark. Referral was done through participants' general practitioner, trade union, or by direct inquiry. All participants were assessed for eligibility by a semi-structured assessment interview with fixed inclusion and exclusion criteria.

A total of 102 participants were included and divided into an Intervention and a Wait-list control group, using a randomized, wait-list controlled design. The intervention was a 3-month group-based stress management program, named MARS-groups in short. Measurements on psychological, biological and social outcomes were collected at baseline, prior to randomization, and at 3-, 6-, and 9-months follow-up. Register-based records of absenteeism were obtained from baseline and 52 weeks onwards.

Outcomes were analyzed with univariate mixed model analysis of variance, the student's t-test, Mann-Whitney U-test, Kaplan-Meier plot and Cox regression.

Results

No differences were found on demographic characteristics between the Intervention and Wait-list control groups at baseline.

On perceived stress a large effect size of the intervention was found, when comparing the intervention to the wait-list control condition. On five coping dimensions investigated, only one dimension—Positive reframing—differed, with a small effect size favouring the intervention. Medium size effects of the intervention were found on self-reported quality of sleep and everyday cognitive errors. The gains achieved were maintained at three months follow-up. Also, the effect of the intervention was repeated, as the Wait-list control group received the intervention, after the initial stay on the wait-list.

On biological markers of stress participants' baseline measures were within clinical and laboratory reference levels. No changes in biological markers were observed from the intervention.

The intervention was found to reduce self-reported absenteeism from work. From register-based records of long-term absenteeism a similar trend was found. No conclusive evidence was found on return to work.

Conclusions and perspectives

The intervention improves participants' measures of perceived stress, use of positive reframing, self-reported quality of sleep and cognitive errors, and may reduce the amount of absenteeism from work.

The evidence suggests that the MARS intervention is an effective measure against the negative psychological and social consequences of work-related stress, once it is manifest for the individual worker.

However, methodological constraints in the study design of the present investigation may question the validity of the present findings. Future research is needed to validate the results obtained, and to continue the sophistication of the methods we use to answer the question of: What are effective measures against work-related stress?

11 Danish summary – Dansk resumé

Baggrund

Arbejdsrelateret stress er identificeret som et betydeligt problem i forhold til trivsel på arbejdspladsen, og er relateret til forringet psykologisk velbefindende, forøget sygefravær og tab i produktivitet.

Interventioner der kan afhjælpe de negative følgevirkninger af arbejdsrelateret stress når det er opstået, vil være et gode både for den enkelte, for virksomheder, og for samfundet.

Formål

Formålet med denne afhandling er at undersøge effekten af et gruppe-baseret, kognitivt funderet stresshåndteringsprogram, rettet mod erhvervsaktive personer med forhøjede symptomer på arbejdsrelateret stress.

Undersøgelsen af effekten sker indenfor en biopsykosocial forståelsesramme, med brug af både psykologiske, biologiske og sociale udfaldsmål.

Undersøgelsespopulation og metoder

Deltagerne blev rekrutteret fra den erhvervsaktive del af befolkningen i den østlige del af region Midt, Danmark. Henvisning foregik via praktiserende læge, fagforeninger, samt ved direkte henvendelse. Alle potentielle deltageres egnethed til deltagelse blev vurderet ved et semi-struktureret interview, med fastlagte inklusions- og eksklusions kriterier.

I alt 102 deltagere blev inkluderet og delt op i en Interventions og en Venteliste-kontrol gruppe, ved brug af et randomiseret venteliste-kontrolleret design. Interventionen bestod i et 3-måneders gruppe-baseret stresshåndteringsprogram, kaldet MARS-grupper. Målinger af psykologiske, biologiske og sociale udfald blev indsamlet ved udgangspunktet, før deltagernes randomisering, og ved 3, 6, og 9 måneders opfølgning. Register-baserede oplysninger om sygefravær blev indhentet fra udgangspunktet og 52 uger frem.

Udfald blev analyseret med univariat mixed model variansanalyse, student's t-test, Mann-Whitney U-test, Kaplan-Meier plot og Cox regression.

Resultater

På demografiske karakteristika sås ingen forskelle mellem Interventions og Venteliste-kontrol gruppen ved udgangspunktet.

For selvoplevet stress blev der fundet en stor effektstørrelse af interventionen, når denne sammenlignedes med venteliste-kontrol tilstanden. På én ud af fem undersøgte håndteringsstrategier—Positiv reformulering—blev der fundet en lille effektstørrelse. Effektstørrelser af medium størrelse blev fundet for selvrapporteret søvnkvalitet og kognitive forglemmelser i hverdagen. De opnåede forandringer blev opretholdt ved opfølgning tre måneder efter programmets afslutning. Desuden blev effekten af interventionen gentaget når Venteliste-kontrol gruppen, efter deres ophold på ventelisten, fik tilbudt interventionen.

På biologiske markører for stress lå deltagernes målinger ved udgangspunktet indenfor kliniske og laboratorie referenceniveauer. Der blev ikke observeret forandringer i biologiske markører som følge af interventionen.

En reduktion i selvrapporteret sygefravær fra arbejdet blev fundet i interventionens favør. Fra register-baserede oplysninger om langvarigt sygefravær blev der fundet en lignende tendens. Der sås ingen signifikante fund for tilbagevenden til arbejde.

Konklusioner og perspektiver

Interventionen forbedrer deltagernes mål for selvoplevet stress, brug af positiv reformulering, selvrapporteret søvnkvalitet og kognitive forglemmelser, og kan potentielt set reducere mængden af sygefravær fra arbejdet.

Den tilvejebragte evidens indikerer at MARS-interventionen er et effektivt virkemiddel mod de negative psykologiske og sociale konsekvenser af arbejdsrelateret stress, når problemet først er opstået for den enkelte.

Der ses en række metodologiske begrænsninger i studiedesignet som kan anfægte validiteten af de fundne resultater. Fremtidig forskning er nødvendig for at validere de opnåede resultater, og fortsat udvikle de metoder vi bruger til at besvare spørgsmålet: Hvad er effektive midler mod arbejdsrelateret stress?

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A Paper I

Original article

Scand J Work Environ Health 2009;35(2):145–152

Changes in stress and coping from a randomized controlled trial of a three-month stress management intervention

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Willert MV, Thulstrup AM, Hertz J, Bonde JP. Changes in stress and coping from a randomized controlled trial of a three-month stress management intervention. *Scand J Work Environ Health.* 2009;35(2):145–152.

Objectives The aim of this study was to investigate whether a group-based stress management intervention, based on principles from cognitive behavior therapy, can reduce stress and alter coping strategies in an occupationally diverse population with extensive symptoms of work-related stress.

Methods Using a randomized wait list control design, 102 participants were divided into two groups: intervention and wait list control. The intervention was a three-month group-based stress management program. Outcomes measures were the Perceived Stress Scale (PSS-10, range 0–40 points) and five dimensions from the Brief COPE questionnaire (range 2–8 points) at baseline and three-, six- and nine-months follow-up. Data were analyzed with a univariate analysis of variance.

Results On the PSS-10 from baseline to three months, the intervention group changed -6.45 (95% CI -8.25– -4.64) points, compared to -1.12 (95% CI -2.94–0.70) points in the wait list control group. The between-groups difference was -5.32 (95% CI -7.89– -2.76) points, equalling a standardized mean difference of -0.84 (95% CI -1.27– -0.42) favouring the intervention. One coping dimension, "positive reframing", differed between the two groups. Here the intervention group changed -0.86 (95% CI -1.25– -0.48) points from baseline to three months, compared to -0.18 (-0.58–0.22) points in the wait list control group. We found a between-groups difference of -0.67 (95% CI -1.24– -0.11) points, equalling a standardized mean difference of -0.48 (95% CI -0.89– -0.07) favouring the intervention. The gains achieved during treatment were maintained when followed up three months later.

Conclusions Treatment is superior to the control condition in positively affecting perceived stress and positive reframing. When followed up, the gains achieved are maintained.

Key terms brief COPE; cognitive behavior therapy; follow-up; group treatment; positive reframing; Perceived Stress Scale (PSS-10); wait list control.

Stress has been found to be associated with heart disease (1) and depression (2), but the nature and strength of these associations have been debated (3). Work-related stress, defined by symptoms of sustained animation and reactivity to demands at work, has been identified as a significant occupational health problem and constitutes a major source of staff absenteeism (4). Common treatment for work-related stress is, at present, often characterized by a passive strategy of extended sick leave. In an attempt to provide a proactive approach, interventions applying psychological stress management often focus on teaching participants alternative coping strategies.

Stress and coping have been linked since the work of Lazarus & Folkman (5, p.31), in which the stress reaction was divided into a primary cognitive appraisal of the situation in terms of "Am I in trouble. . .?" and a secondary cognitive appraisal of the situation in terms of "What if anything can be done about it?"

Stress management programs can be divided into preventive or curative interventions. We found only four studies evaluating curative interventions (6–9), compared to a large number of preventive intervention studies. This division compares well with that shown in a recent review by van der Klink et al (10), in which

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none of the 48 studies identified had a curative scope. Another dimension of stress management programs is the nature of the intervention. Van der Klink et al (10) identify four categories of interventions: (i) cognitive behavior therapy, (ii) physical exercise, (iii) relaxation/meditation, and (iv) organizational interventions, all of which can appear alone or in combination. In comparing these approaches, the authors conclude that cognitive behavior therapy is the more effective intervention and already an established evidence-based treatment for clinical depression and anxiety (11).

Searching the literature, we did not identify any studies that (i) were randomized controlled trials, (ii) recruited participants from the general population, (iii) were curative, and (iv) utilized group-based cognitive behavior therapy. One study by Gardner et al (12) used a wait list control design to investigate the effect of a stress management training program on healthcare professionals, but includes participants both with and without elevated stress. Another study by Nickel et al (7) used a randomized design with a placebo control condition, but was limited only to men. A third study by de Jong & Emmelkamp (13) used a randomized controlled design, but recruited participants through an employment agency.

In summary, our study focused on a curative three-month group-based stress management intervention targeted at individuals in the general working population with highly elevated symptoms of work-related stress. The goal of the stress management program was to encourage participants to reflect on their current coping strategies, assess their usefulness and introduce more functional coping strategies. Our study aimed to evaluate the effectiveness of this approach on perceived stress and coping of participants.

This is the first paper reporting on the so-called MARS (measures against work-related stress) trial in which stress and coping have been predefined as the main psychological outcome measures.

Study population and methods

Design and timeframe

The study used a randomized wait list control design (figure 1). Participants were randomized into either the intervention or wait list control groups. Outcome

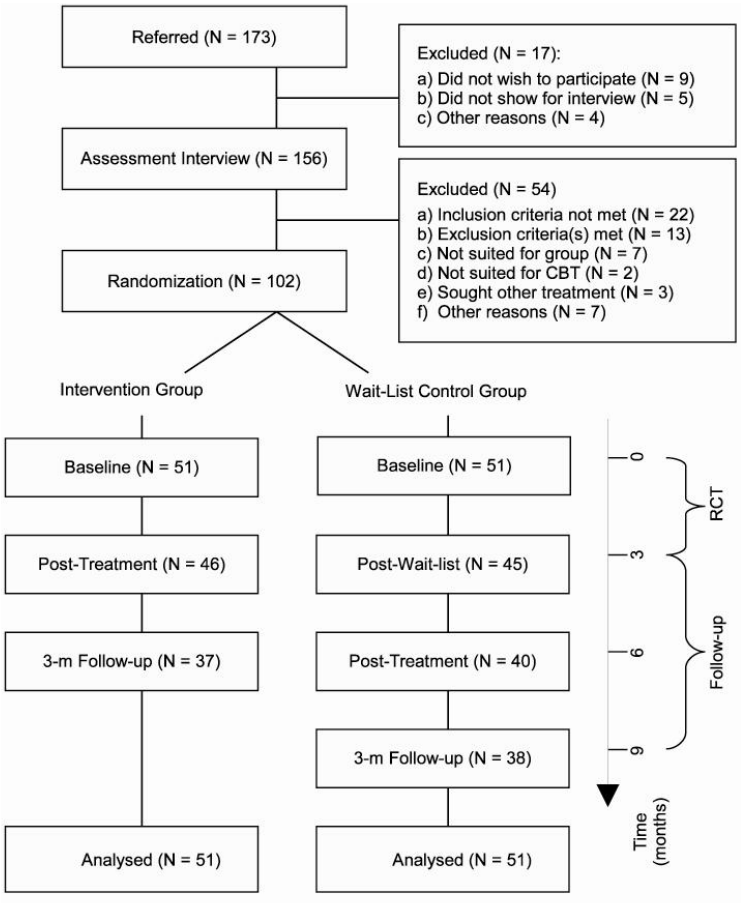

Figure 1. Flowcart of participants' progress through the phases of the trial.

variables were measured at the baseline and at three-, six-, and nine-months follow-up.

A sample size of 90 was needed to detect a between-groups difference of one standard deviation on the Perceived Stress Scale (PSS-10, range 0–40 points). The estimate was based on a significance level of 95%, power 80%, standard deviation of 5 points, an intra-class correlation coefficient 0.15, and an average cluster size of 9. An allowance for a 10% dropout of 102 participants was included.

An external consultant performed a randomization, in blocks of six, using the RANNOR computer algorithm (SAS Inc, Cary, NC, USA). Results were placed in sealed envelopes and handled by the project secretary. To minimize the differences between the groups, we mixed the participants from the intervention and wait list control groups when new groups were formed.

Inclusion and randomization was performed over a period of ten months from December 2006 through September 2007, with groups running in succession from January to December 2007.

Referral

Participants came from the working population (18–67 years) in the municipality of Aarhus and its surrounding communities. Referral was available for local general practitioners (GP), union social workers and through direct inquiry. All potential participants were assessed by a physician – either their GP prior to referral or a resident occupational physician. The project was promoted via letters sent to local GP, meetings with union social workers, a website, and advertisements in a local newspaper. A total of 173 persons were referred for participation, as illustrated in figure 1. Of this initial number, 156 persons were invited to an assessment interview to determine their eligibility, while 17 potential participants were excluded. On the grounds of the assessment interview, 102 persons were invited and accepted to participate, while 54 persons could not be included. All persons excluded from the study were given advice on other alternatives.

Eligibility

Inclusion criteria were persistent symptoms of work-related stress, defined as physiological and psychological symptoms of sustained animation lasting more than four weeks and elevated reactivity of symptoms to demands at work. Another criterion for participation in the was a time sequence during which, within the last six months, major organizational or other changes at work (eg, increased caseload, long-term sick leave among colleagues, or no substitutes available to fill in) preceded the stress reaction. Those eligible to participate had to be motivated to remain employed and planned return to work within four weeks if they were on sick leave. Participants were either on sick leave following a GP assessment or active at their workplace. For the latter, a score of ≥20 points on the PSS-10 was required, one standard deviation above the population mean reported by Cohen (14).

Exclusion criteria included the following: (i) being on sick leave for more than 26 consecutive weeks, (ii) having substantial psychosocial strains outside of work, (iii) bullying as the main problem, (iv) a severe psychiatric condition or history of repeated psychiatric conditions, and (v) current abuse of alcohol or psychoactive stimulants.

When determining caseness for work-related stress, it was not possible to ascertain retrospectively whether the cause of stress experienced by the individual was purely work-related, but work was, in all cases, a contributing factor in sustaining the present state.

Assessment

A clinical psychologist with more than five years training assessed all potential participants in an interview based on a semi-structured format covering the criteria for participation outlined earlier. The psychologist completed a structured form during every interview.

In addition to the interview, the study used four questionnaires [PSS-10 (14), Life Events (15), the Nordic Basic Sleep Questionnaire (16) and the Outcome Rating Scale (17)] to assess eligibility.

Allocation

Upon completing the baseline measurement, an independent person opened the envelope containing the participant's allocation. Following randomization, a total of 51 participants comprised the wait list control group and 51 participants made up the intervention group. In the first three months after the baseline, five and six participants dropped out from the intervention and wait list control groups respectively (figure 1). No systematic differences were found regarding the characteristics of participants who dropped out of the study.

Intervention

There were nine participants per group, spanning eight three-hour sessions over a period of three months. An experienced clinical psychologist led each group. The groups met for weekly sessions the first four weeks, and then every fortnight for the remaining four sessions. The themes of the eight sessions were the following: (i) introduction to cognitive behavior therapy, (ii) psychoeducation on stress, (iii) identification of dysfunctional thinking, (iv) modification of dysfunctional thinking,

(v) communication and stress, (vi) communication skills training, (vii) implementation of strategies at work, and (viii) review of techniques.

Outcome measures

The PSS-10 (14) is a self-reported measure of global stress and measures the extent to which people find their life unpredictable, uncontrollable, and overwhelming. It consists of ten questions rated on a 5-point Likert scale ranging from "never" to "very often" (range: items 0–4, total 0–40). The scale has a Cronbach's α of 0.78 (14). A Danish translation of the PSS-10 was used. In our study, the PSS-10 had a Cronbach's α of 0.81.

The Brief COPE questionnaire (18) measures the use of different coping strategies. It is a 28-item questionnaire that measures 14 dimensions of coping. Each item is rated on a 4-point Likert scale ranging from "a lot" to "never" (range: items 1–4, dimensions 2–8).

Five of the 14 dimensions represented in Brief COPE were of special interest in this study, these include: (i) emotional support (seeking support and comforting from others), (ii) instrumental support (seeking advice and help from others), (iii) active coping (taking action to change the situation), (iv) planning (considering future steps and strategies), and (v) positive reframing (changing perspective and focusing on positive aspects). All five dimensions have Cronbach's α of 0.64–0.73 (18). The study used a Danish translation of Brief COPE, translated and back-translated by a group at the Department of Occupational Medicine, Herning Hospital. In the present translation and study sample, the five dimensions of Brief COPE had Cronbach's α in the 0.70–0.82 range.

Table 1. Demographics and baseline characteristics.[a, b]

Characteristics	Intervention		Wait list control	
	N	%	N	%
Gender				
Female	41	80.4	43	84.3
Male	10	19.6	8	15.7
Referred by				
GP	24	47.1	29	56.9
Union	4	7.8	6	11.8
Phone	23	45.1	16	31.4
Sick leave				
Full	20	39.2	20	39.2
Partial	14	27.5	16	31.4
Contacted GP	49	96.1	50	98.0
School education				
9 years	10	9.8	11	10.8
12 years	41	40.2	39	38.2
Further education				
Short (<3 years)	18	17.6	14	13.7
Medium (3-4 years)	28	54.9	29	56.9
Long (>4 years)	5	9.8	7	13.7
Occupation (by field)				
Social	14	27.5	15	29.4
Health	7	13.7	9	17.7
Teaching	9	17.7	5	9.8
Administration	10	19.6	3	5.9
Other	10	19.7	13	25.5
Taking medication	21	41.2	25	49.0
Medication (by type)				
Anti-depressive	15	29.4	10	19.6
Hypertensive	2	2.0	5	4.9
Hypothyroidism	4	3.9	4	3.9

[a] Mean age for the intervention group was 44 years (range 28–61 years) and for the wait list control group 46 years (range 24–58 years), respectively.

[b] Mean years in the workforce for the intervention group was 18 years (range 1–38 years) and for the wait list control group 17 years (range 2–37 years), respectively.

Statistical analysis

Statistical analysis was performed using the STATA (Stata Corp LP, College Station, TX, USA) and WinPEPI (Brixton Health, London, United Kingdom) software packages. The data were analyzed blinded, by letting an external consultant recode the grouping variable. The blinding was kept unbroken until final conclusions were drawn about the results.

Baseline characteristics were compared using the Chi-squared test of comparable distributions and the Student's t-test. Outcome analyses were performed as intention-to-treat with a mixed model univariate repeated measures analysis of variance. Model validation was performed using Bland-Altman plots, QQ-plots of the residuals and sum-residual plots. To enable comparison between the different measures, effect sizes were calculated using Cohen's d (19). Estimates were reported with their 95% confidence intervals (95% CI).

Results

Baseline characteristics

Demographic and baseline characteristics for the intervention and wait list control groups are presented in table 1. No significant differences were found between the two groups.

Outcome measures

In the present study design, the wait list control group could no longer function as a control group as the timeframe moved beyond three months after baseline. Therefore, the results from the analysis of the outcome

measures fell into two categories. In the baseline 3-month timeframe, the results from the randomized controlled trial were reported. From 3-9 months, the results from the follow-up study were reported.

Randomized controlled trial

The changes on the outcome measures from 0-3 months are displayed in figure 2. Significant differences were found on the PSS-10 and Brief COPE dimension of positive reframing when comparing changes over time between the groups. Regarding the remaining four Brief COPE dimensions (emotional support, instrumental support, active coping, and planning), no differences were found between the groups; consequently no further results have been displayed for these outcome measures.

In table 2, the results for the PSS and positive reframing dimension scores are presented for the randomized controlled trial. After stating the baseline mean score on the two scales, the difference from baseline 3-months is displayed first as the 0-3 month change for each group in terms of points on the scale, and next as standardized mean differences (Cohen's d). In the third row, the intervention effect (the difference between the changes over time in the two groups) is displayed, both as points on the scales and as standard mean deviation.

Follow-up study

After three months of waiting, participants in the wait list control group were offered the stress management intervention. From this point on, the two groups were no longer comparable. However, the two groups were still followed up independently and continued to supply information on the effect of the intervention.

Table 3 shows the analysis of the PSS-10 and positive reframing dimension scores in the 3-6 month timeframe for the intervention group, and for the 3-9 month timeframe for the wait list control group. From 0-3 months, intervention group participants, who had completed their treatment and were only followed up, maintained the gains they had achieved during treatment. The wait list control group, receiving treatment after being on the waiting list, showed a positive response with a significant drop in both the PSS-10 and positive reframing dimension scores.

When followed up three months after termination of their treatment, in the 6-9 month timeframe, wait list control group participants also maintained the gains achieved during treatment.

Table 4 is an alternative version of tables 2 and 3 combined.

Study homogeneity

To assess homogeneity, analyses were performed to check whether any of the following factors influenced the study's outcome: (i) participation in different treatment groups, (ii) referral route, or (iii) group leader. No significant effects were found.

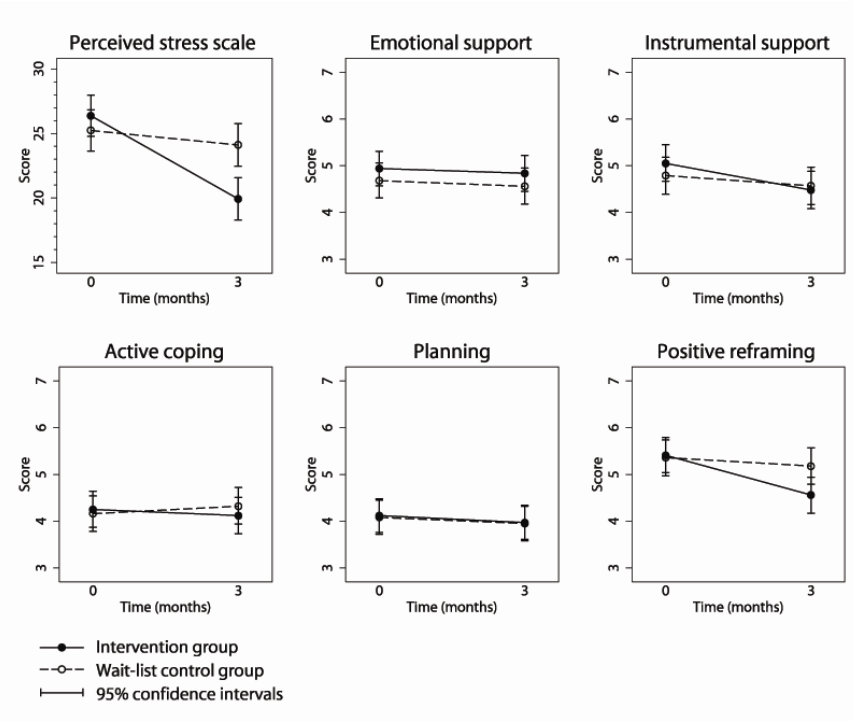

Figure 2. Changes on outcome measures from baseline (0-3 months).

Table 2. Baseline scores and within-group changes over time from the randomized controlled trial. The effect of the intervention is estimated as the between-groups difference of the changes from 0-3 months. Effect sizes are reported using Cohen's d (standardized mean difference). (95% CI = 95% confidence intervals, SD = standard deviation)

	Baseline			0–3 months			Effect size (d)	95% CI
	Score	SD	95% CI	Within-group change	P-value	95% CI		
Perceived stress scale								
Intervention	26.37	5.80	24.79–27.97	-6.45	0.000	-8.25– -4.64	-1.11	-1.42– -0.80
Wait list control	25.23	5.81	23.64–26.83	-1.12	0.226	-2.94–0.70	-0.19	-0.51–0.12
Intervention effect	.	.	.	-5.32	0.000	-7.89– -2.76	-0.92	-1.36– -0.48
Positive reframing								
Intervention	5.41	1.37	5.04–5.79	-0.86	0.000	-1.25– -0.48	-0.62	-0.91– -0.33
Wait list control	5.36	1.38	4.98–5.74	-0.18	0.376	-0.58–0.22	-0.13	-0.42–0.16
Intervention effect	.	.	.	-0.67	0.019	-1.24– -0.11	-0.49	-0.90– -0.08

Table 3. Scores at three months and within-group changes over time from the follow up study. (95% CI = 95% confidence intervals)

	3 months		3–6 months			6–9 months		
	Score	95% CI	Within-group change	P-value	95% CI	Within-group change	P-value	95% CI
Perceived stress scale								
Intervention	19.93	18.29–21.57	-1.03	0.305	-3.00–0.94	.	.	.
Wait list control	24.11	22.46–25.76	-3.99	0.000	-5.91– -2.06	-1.02	0.343	-2.98–0.94
Positive reframing								
Intervention	4.56	4.17–4.94	0.07	0.747	-0.37–0.51	.	.	.
Wait list control	5.18	4.79–5.57	-0.44	0.043	-0.87– -0.01	-0.34	0.123	-0.77–0.09

Table 4. Alternative version of tables 2 and 3 combined: baselines scores and within-group changes over time. The effect of the intervention is estimated as the between-groups differences of the changes from 0–3 months. Effect sizes are reported using Cohen's d (standardized mean difference). (95% CI = 95% confidence intervals, SD = standard deviation, SE = standard error of the mean)

	Baseline		Randomized controlled trial				Follow-up study					
	Score	SD	0–3 months [a]	SE	P-value	Effect size (d)	3–6 months [a]	SE	P-value	6–9 months [a]	SE	P-value
Perceived stress scale												
Intervention	26.37	5.80	-6.45	0.92	0.000	-1.11	-1.03	1.00	0.305	.	.	.
Wait list control	25.23	5.81	-1.12	0.93	0.226	-0.19	-3.99	0.98	0.000	-1.00	1.05	0.343
Intervention effect	.	.	-5.32	1.31	0.000	0.92	.	.	.	.	.	.
Positive reframing												
Intervention	5.41	1.37	-0.86	0.20	0.000	-0.62	0.07	0.22	0.747	.	.	.
Wait list control	5.36	1.38	-0.18	0.20	0.376	-0.13	-0.44	0.22	0.043	-0.34	0.22	0.123
Intervention effect	.	.	-0.67	0.29	0.019	-0.49	.	.	.	.	.	.

[a] Within-group change.

Discussion

In the randomized controlled trial, intervention was more effective than the no-treatment wait list control condition in reducing perceived stress and strengthening the coping dimension of positive reframing. The effect of the intervention was approximately a five-fold greater change in numerical scores on the two measures. According to Cohen's division of effect sizes (19), the standard mean deviation found on the PSS-10 Stress Scale can be labeled as large (>0.8), whereas the difference for positive reframing can be considered small (<0.5).

The follow-up study showed that the gains achieved during treatment were maintained three months after termination of treatment. Strengthening the results from the randomized controlled trial, a similar effect of the intervention was replicated for the wait list control group, when they were given the opportunity to participate in the intervention. A limitation of the findings was, however, that in a clinical and occupational perspective, the three-month follow-up period was not sufficient to determine the long-term effects of the intervention.

No significant changes were found in the coping dimensions of (i) emotional support, (ii) instrumental support, (iii) active coping, and (iv) planning, even though these dimensions were integrated in the treatment manual. As a possible explanation, one could differentiate between behavior- and attitude-oriented coping dimensions. Such a distinction would label the aforementioned coping dimensions as behavior-oriented, and positive reframing as an attitude-oriented coping dimension. As such, the intervention may be more effective in changing attitude-oriented than behavior-oriented coping.

Interpreting the overall findings, the results concerning perceived stress can be considered quite robust. Interpretation of the results of the positive reframing dimension requires more caution, considering that five different aspects of coping were investigated, thus increasing the risk of a Type I error, and the probability value for changes on the coping dimension of positive reframing was significant at the 95% confidence interval level but below 99%.

Compared to a conventionally controlled design, the wait list control design imposed limitations regarding the conclusions that can be drawn from the study. Allowing the wait list control group to "cross over" and receive treatment was been an ethical and logistical consideration that attempted to ensure a high degree of motivation in the control group while still maintaining a partially controlled design. It was feared that participants randomized to a control condition throughout the trial would have low motivation to continue participating after their allocation or be prone to seek help elsewhere while acting as controls.

Another methodological constraint lay in the lack of standard measures for both stress and coping. The PSS-10 and Brief COPE questionnaire were chosen as a result of a number of considerations, but were not definitive measures of their subject matter. A common critique against questionnaires is the subjective nature of the data collected – a critique that may also be justified in our study, but it was a choice that reflects the use of the best measures available.

One characteristic of the intervention is that it took place away from the workplace. Interventions that are onsite can perhaps be tailored more precisely to the particular setting, ensuring a tighter integration of the coping strategies learned in the groups and their implementation in everyday routines. To counter this possibility, we emphasized homework assignments and gave the intervention participants an opportunity to implement the strategies learned in the groups at the workplace.

It is important to distinguish between the outcome measures and the concept of work-related stress when interpreting the results. Perceived stress and positive reframing were shown to change, but the degree to which these changes were a direct reflection of changes in work-related stress could not be answered exhaustively in our study. When compared to previous results from similar studies (12, 7, 13), our trial supported the findings that stress management interventions based on cognitive behavior therapy can lower perceived stress. Expanding on what is known from previous studies, our trial suggests that this type of intervention is effective also when applied to a sample recruited from the general population, having symptoms of elevated levels of stress and coming from a wider range of diverse occupations than in previous trials.

Participants were mainly white-collar workers from the social, health, teaching and administrative work fields. Though more diverse in terms of occupation than the aforementioned previous trials, the relative occupational homogeneity may have weakened the external validity of the study, leaving partially unanswered the question of the effectiveness of the intervention when applied elsewhere, ie, blue-collar workers.

With respect to coping, previous studies' findings point in different directions. Both Gardner et al (12) and de Jong & Emmelkamp (13) found that individual coping style did not change as a result of treatment, while Timmerman et al (20) found that one dimension of coping (ie, facing and solving problems) changed, while other dimensions did not. In our study, another dimension of coping (ie, positive reframing) changed during the intervention while other investigated dimensions did not. These results question if coping is measured adequately or if there may be a need revisit the role of coping in stress management interventions.

The stress management program and the accompanying manual was a feasible, effective, and resource-efficient format for offering an intervention to the target group. It was a relatively short program of eight three hour sessions spanning over three months, but still substantial enough to initiate changes. Dropout from the groups was low and verbal feedback from the participants was mainly positive.

In summary, this study has shown that stress management intervention is effective in lowering perceived stress for working individuals who have elevated symptoms of work-related stress and are actively seeking help. A less robust and smaller effect was found for the use of positive reframing to cope with the situation.

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B Paper II

Sleep and Cognitive Failures Improved by a Three-Month Stress Management Intervention

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*Work-related stress is a major occupational health problem. Prominent symptoms are impaired sleep and cognitive ability. Participants (*N = *102) were randomized to either an intervention or a wait-list control group. Outcomes, measured at baseline, 3, 6, and 9 months, were the Basic Nordic Sleep Questionnaire, Cognitive Failures Questionnaire, and Digit Span test. Data were analyzed using repeated measures analyses of variance. Self-reported quality of sleep improved in the intervention group. Relative to the control group, an effect size of* d = −0.64, CI [−1.05, −0.24], *was found. For cognitive failures, an effect size of* d = −0.57, CI [−0.90, −0.24], *was found, favoring the intervention. Gains were maintained at follow-up. Digit Span scores did not differ between groups. In conclusion, the intervention had medium effects on self-reported sleep and cognitive errors.*

Keywords: cognitive–behavior therapy, group treatment, wait-list control, sleep, cognitive performance

In Western societies, work-related stress, defined by symptoms of sustained arousal and reactivity to demands at work, has been identified as a significant occupational health problem and constitutes a major source of staff absenteeism (Borg et al., 2000).

In the clinic, poor quality of sleep, such as trouble falling asleep, frequent nightly wakings, early awakening, and bedtime ruminations, are some of the most commonly reported symptoms in individuals with complaints of work-related stress. Other frequently reported symptoms are cognitive failures in

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everyday tasks, for example, forgetting what one was doing, forgetting what to fetch, forgetting names and appointments, and similar problems related to deficiencies in attention and memory. In addition, complaints regarding reduced problem-solving and learning abilities are also frequent (Schaufeli & Enzmann, 1998). These symptoms are seen as impediments to perform satisfactorily at work.

SLEEP AND STRESS

Sleep is recognized as a fundamental human need (Maslow, 1943), and poor quality of sleep has been associated with a number of adverse health outcomes, ranging from increased risk of mortality (Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002), heart disease (Nilsson, Nilsson, Hedblad, & Berglund, 2001), and diabetes (Nilsson, Rööst, Engström, Hedblad, & Berglund, 2004) to predicting long-term sick leave (Akerstedt, Kecklund, Alfredsson, & Selen, J2007). Normal duration of sleep in Western societies is estimated as 7–8 hr per night; duration of sleep below 6 and above 9 hr per night has been found to be associated with increased mortality (Youngstedt & Kripke, 2004).

Work characteristics, including effort–reward imbalance and demand–control imbalance, have been associated with poor quality of sleep (De Lange, Taris, Kompier, Houtman, & Bongers, 2004; Kudielka, Von Kanel, Gander, & Fischer, 2004). The causality of these associations can be assumed to be bidirectional because adverse psychosocial work conditions can lead to poor sleep through heightened hypothalamic–pituitary–adrenal axis activation, with special focus on the role of the hormone cortisol, and an increase in nightly ruminations. On the other hand, poor quality of sleep can reversely color the perception of the working environment in a negative direction, as degraded quality of sleep has been found to impair the individual capacity for problem solving and handling of everyday tasks (Beersma, 1998), making the handling of work tasks seem harder when one is not properly rested.

According to a review by Akerstedt (2006), earlier cross-sectional studies have demonstrated that stress is closely related to impaired sleep. It has also been shown that apprehension of a difficult next working day is related to poorer sleep quality. Sleep recordings demonstrate that stress is associated with shortened sleep, fragmentation, and possibly a reduction in the deepest stages of sleep. This opens a feedback mechanism, where shortened or disturbed sleep may act as a stressor in itself, as the following working day requires more effort, thus adding to the individual's psychophysiological stress reaction. However, as Akerstedt concluded much knowledge is still lacking, particularly on the effects of real-life work stress investigated in longitudinal research designs.

From the field of sleep research, the diagnosis of primary (psychophysiological) insomnia is based on subjective complaints of difficulties falling or staying asleep or nonrestorative sleep that is associated with distress or daytime impairments. It is more common among women, middle-aged or older adults, and patients with medical or psychiatric disorders. In clinical practice, sleep disturbances are assessed by the individual's subjective experiences of disturbed sleep, and often focus on how to overcome barriers preventing good quality of sleep. In laboratory, or basic, sleep research, insomnia or other sleep disturbances may be measured by polysomnography, which monitors physiological parameters such as brain activity, eye movements, muscle activity, and heart rhythm during sleep, and aims at gaining a greater understanding of sleep disturbances. Our main focus in the present article is on the role of sleep disturbances from a clinical practice perspective.

Subjective and objective measures of sleep are not always in accord with one another. However, in a recent study, a group of patients suffering from severe occupational burnout had poorer quality of sleep on subjective and objective measures of sleep when compared with a group of healthy controls (Ekstedt et al., 2006).

In a review by Morin et al. (2006) of psychological treatments for primary insomnia, treatments based on cognitive–behavior therapy and targeted specifically at sleep problems have been found to produce reliable changes in several parameters, among these sleep efficiency and time awake after sleep onset. Morin et al. noted that there is a need for additional prospective and randomized controlled studies of comorbid insomnia contrasting outcomes when sleep is or is not directly targeted in treatment (p. 1410). It is proposed that the present study could be one such study, where participants with primary symptoms of work-related stress exhibit comorbid signs of insomnia and participate in a stress management intervention that does not directly target sleep.

COGNITIVE PERFORMANCE AND STRESS

Cognitive failures, as conceptualized by Broadbent, Cooper, FitzGerald, and Parkes (1982), denote cognitive-based errors in performing simple everyday tasks that a person should normally be capable of executing without error. Cognitive failures have been investigated in a number of settings and have been associated with work-related stress, burnout, chronic fatigue syndrome, and psychiatric illness (Mahoney, Dalby, & King, 1998; Van Der Linden, Keijsers, Eling, & Van Schaijk, 2005; Wagle, Berrios, & Ho, 1999; Wearden & Appleby, 1997).

Impairment in cognitive performance, as measured by neuropsychological tests, has been associated with chronic stress (Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005), but the exact nature and strength of the relationship is yet unclear.

MAINTAINING ROLE OF IMPAIRED SLEEP AND COGNITION

Poorer sleep and reduced cognitive ability can be viewed as consequences of work-related stress as well as maintaining factors for the worker's (dis)ability to meet the demands required by the job. It is in the latter maintaining capacity that poor sleep and reduced cognitive ability are understood in the present context. This understanding is equivalent to that of cognitive–behavior therapy for depression, where depressive symptoms are seen as signs of depression as well as factors that are actively maintaining the depression (Beck, Rush, Shaw, & Emery, 1979).

The American Academy of Sleep Medicine (Morgenthaler, et al. 2006) has put forth evidence-based recommendations on techniques for treatment of primary and secondary insomnia, including cognitive–behavior therapy, sleep restriction, paradoxical intervention (i.e., remain passively awake), stimulus control, sleep hygiene, relaxation training, and biofeedback training. However, these techniques are not directed at stressed workers per se, although they may be effective for this group also.

To our knowledge, there are no studies investigating whether quality of sleep, amount of cognitive failures, and cognitive performance can be modified by an occupational stress management intervention directed at individuals with elevated symptoms of work-related stress. Besides increasing the existing knowledge base for stress management, such a study will provide further insight into the relationship between psychosocial stressors on the one side and sleep quality and cognitive functioning on the other side.

The aim of this study was to investigate changes in self-reported sleep, amounts of cognitive failures, and cognitive performance following a curative 3-month group-based stress management intervention addressing actively help-seeking individuals in the general working population with substantial amounts of work-related stress. We hypothesized that the stress management intervention would bring about greater positive changes on the outcome measures compared with a control condition.

This is the second report on the trial known by the acronym MARS (Measures Against Work-Related Stress). The first report was on changes in perceived stress and coping dimensions following the intervention (Willert, Thulstrup, Hertz, and Bonde, 2009).

STUDY POPULATION AND METHOD

Design and Timeframe

The study was carried out within a randomized wait-list control design (see Figure 1). Participants were randomized to either the intervention group or to a wait-list control group. Outcome variables were measured at baseline and at 3-, 6-, and 9-month follow-up.

The sample size needed was calculated to be 90 participants. This allowed detection of a between-groups difference of 1 standard deviation from the score at baseline on the main outcome measure of the study, the Perceived Stress Scale (S. Cohen & Williamson, 1988). The sample size calculation was based on setting the significance level to 95%, power to 80%, standard deviation to 5, intraclass correlation coefficient to .15, and average cluster size to 9. The scales used in the present investigation share psychometric properties with the Perceived Stress Scale, and the above sample size was therefore deemed sufficient in the present context as well. To allow for a 10% dropout, we included 102 participants.

Randomization in blocks of six was used and was achieved using the RANNOR computer algorithm of the SAS statistical software package. The randomization procedure was handled by an external consultant and placed in sealed envelopes handled by the project secretary. To ensure equal group impact and minimize intraclass correlation, we mixed participants from the intervention and the wait-list control condition when forming groups.

Participants were included over a period of 10 months from December 2006 through September 2007, with groups commencing in succession from January through December 2007.

Referral

Persons from the working population (18–67 years of age) in the municipality of Aarhus, Denmark, and its surrounding communities could participate in the study. Referral was available for local general practitioners, union social workers, and through direct inquiry. All potential participants were assessed by a physician, either by their general practitioner prior to referral or by a resident occupational physician. Advertisement for the project was done through letters sent to local general practitioners, meetings with union social workers, a Web site, and announcements in a local newspaper.

We did not a priori know the total universe of potential participants from the study's population base of approximately 660,000 citizens. For reference, however, we did know that the annual referral of patients with psychological

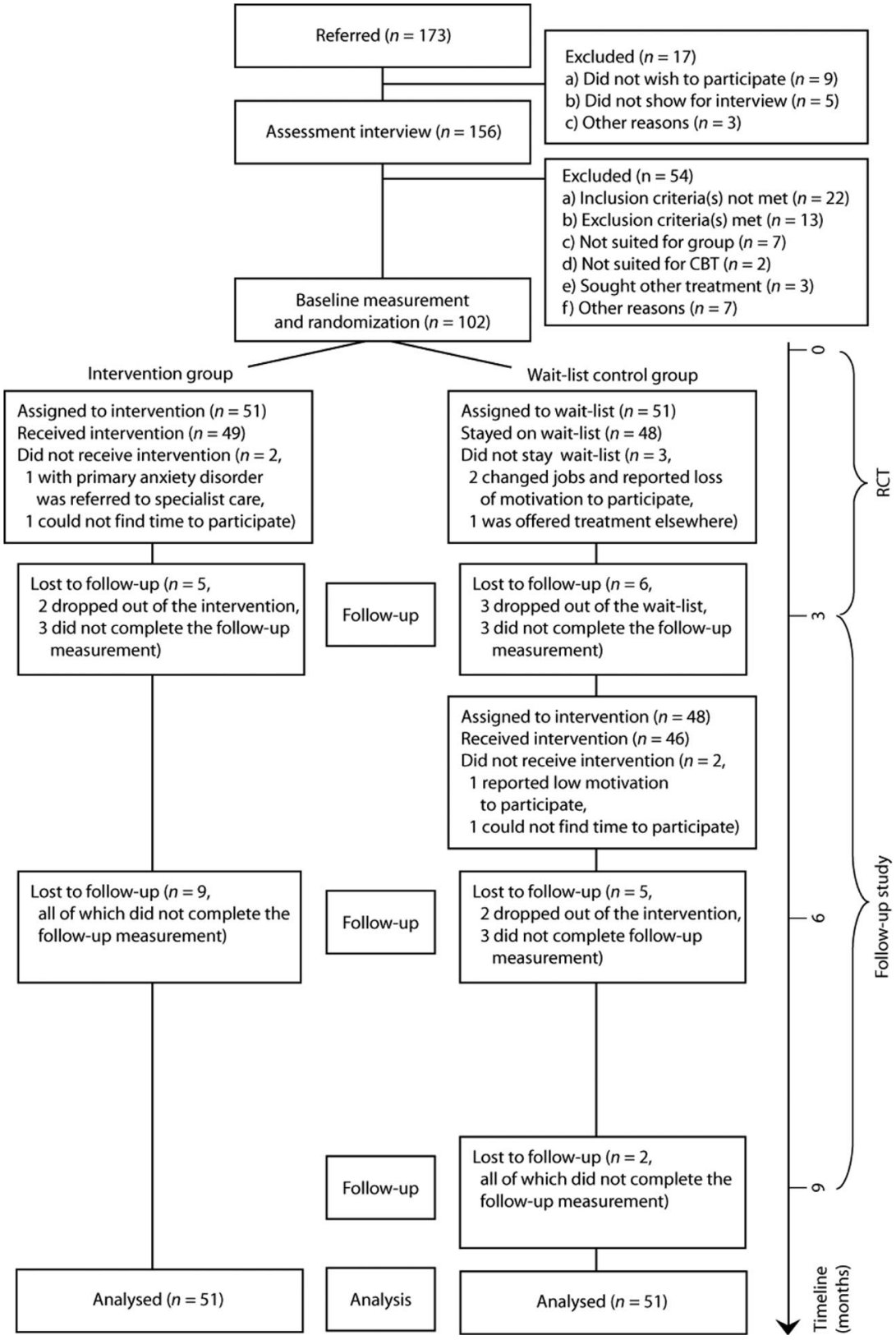

Figure 1. Flowchart of participants' progress through the phases of the trial.

complaints to the Department of Occupational Medicine, where the project took place, was 300 persons per year before the project was initiated. To be referred, one's general practitioner or union social worker must have read the information given about the new project, or for the self-referred participants, they must have read the local newspaper in the week the project was advertised. These random selection factors may have influenced the population sample that did get referred to the project.

In total, 173 persons were referred to participate (see Figure 1). Of this group, 156 persons were invited to an assessment interview to determine eligibility, and 17 potential participants were excluded (see Figure 1 for reasons). From the assessment interview, we invited 102 persons to participate, and 54 persons were not included (see Figure 1 for reasons). All persons not included were informed about alternatives.

Assessment

Potential participants were given a semistructured assessment interview by a clinical psychologist (>5 years' training). The interview covered the following topics: current work status (at work, partial or full sick leave), duration of sick leave and expected return to work, account of events at work leading to current situation, physiological and psychological symptoms of stress, family/social life, and personal coping style, duration of contact with general practitioner, current medication, history of previous psychiatric treatment, and current use of alcohol or psychoactive stimulants.

In addition to the interview, the Perceived Stress Scale (S. Cohen & Williamson, 1988), the List of Threatening Experiences questionnaire (Brugha, Bebbington, Tennant, & Hurry, 1985), Basic Nordic Sleep Questionnaire (Partinen & Gislason, 1995), and Outcome Rating Scale (Miller, Duncan, Brown, Sparks, & Claud, 2003) were used when assessing eligibility.

Eligibility

Inclusion criteria were persistent symptoms of work-related stress, defined by physiological and psychological symptoms of sustained arousal lasting more than 4 weeks, and elevated reactivity of symptoms to demands at work. Motivation to remain employed and, if on sick leave, a planned return to work within 4 weeks were required. Participants were either on sick leave, through assessment by their doctor, or working. For the latter, a score of 20 points or above on the Perceived Stress Scale was required (equaling

1 standard deviation above the population mean; S. Cohen & Williamson, 1988).

Exclusion criteria were more than 26 consecutive weeks of sick leave, substantial psychosocial strains outside of work, bullying as the main problem, severe psychiatric condition or a history of repeated psychiatric conditions, and current abuse of alcohol or psychoactive stimulants.

Allocation

After the baseline measurement, an independent person opened an envelope containing the participants' allocation. After randomization, 51 participants were in the wait-list control group, and 51 participants made up the intervention group. In the first 3 months after baseline, six participants dropped out from both the intervention and the wait-list control groups (see Figure 1).

Intervention

There were eight 3-hr sessions over a period of 3 months with nine participants each. Sessions were led by one of two experienced clinical psychologists. Groups met for weekly 3-hr sessions the first 4 weeks and then every fortnight for the remaining four sessions. Topics for the sessions were (a) introduction to cognitive–behavior therapy, (b) psychoeducation about stress, (c) identification of dysfunctional thinking, (d) modification of dysfunctional thinking, (e) communication and stress, (f) communication skills training, (g) implementation of strategies at work, and (h) review of techniques. The main focal point for the intervention throughout the sessions was coping with stressful situations at work and implementing new coping strategies at the workplace through homework assignments between group sessions.

The first group session was an introduction to the course as a whole and techniques used in cognitive–behavior therapy. The subsequent seven sessions were formatted as follows: Each group session was initiated by a short mindfulness exercise, "Breathing Space." After this, participants reported on the progress of their homework and any success or difficulties they had met. The topic of the day's session was then presented by the group leader in a slideshow presentation and discussed with the group. After the presentation, the group split into smaller units of two or three participants to do group work on the topic of the session. In some group sessions dealing with communication skills, group work was substituted with role-playing exercises. Each

session ended with new homework assignments and a discussion detailing each participant's approach to the assignment. (Further information regarding the intervention is available by contacting the first author.)

In the second group session, Bootzin's (2000) recommendations for cognitive–behavioral treatment of insomnia, as well as healthy sleeping habits, were introduced. Apart from this session, the topic of sleep was not included in the intervention manual.

Outcome Measures

Outcomes were self-reported quality of sleep, number of hours spent in bed, amount of everyday cognitive failures, and the Digit Span test. Each outcome is described in detail below. By relying mainly on self-report measures, the clinical practice perspective of the study is underlined, as we gain information on participants' perception of their sleep and cognitive ability, rather than the more objective measures one can obtain from basic laboratory research on sleep and cognition.

Basic Nordic Sleep Questionnaire

The Danish version of the Basic Nordic Sleep Questionnaire (BNSQ; Partinen & Gislason, 1995) was used to assess quality of sleep. The scale has been shown to have good internal consistency, and has been used in a range of both epidemiological and clinical settings (Partinen & Gislason, 1995).

A selection of seven items regarding quality of sleep was made from the original 27 items in the full BNSQ. The full BNSQ contains questions on a broad selection of sleep disturbances, among these snoring and sleep apnea, which were deemed less relevant to the participant with work-related stress. The selected items reflected our best clinical judgment of relevant sleep problems encountered in the study population.

The seven selected items covered the domains of overall sleep quality, trouble falling asleep, waking during the night, number of wakings per night, early wakening, sleepiness in the morning, and sleepiness during the day. Each item was scored on a 5-point Likert scale. Item 1 ranged from 1 (*good*) to 5 (*poor*); Items 2, 3, and 5 ranged from 1 (*never or only once a month*) to 5 (*every night or almost every night*); Item 4 ranged from 1 (*no wakings*) to 5 (*at least five wakings*); Item 6 ranged from 1 (*never or only once a month*) to 5 (*every morning or almost every morning*); and Item 7 ranged from 1 (*never or only once a month*) to 5 (*every day or almost every day*). Respondents were asked to assess their sleep within the past 4 weeks prior to

responding. A Cronbach's alpha of .69 was found for the selected items and the present sample.

On the BNSQ, the respondents were also asked to state at what time they typically go to bed in the evening and rise in the morning, making it possible to calculate the number of hours spent in bed during the night.

Cognitive Failures Questionnaire

The Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982) was used to measure everyday cognitive errors. The questionnaire was designed to assess the frequency of lapses in three areas, perception, memory, and motor function, and was proposed by the authors to tap a single factor coined "cognitive failures." The questionnaire consists of 25 items that are scored on a 5-point Likert scale ranging from 0 (*never*) to 4 (*very often*). Respondents were asked to assess the amount of cognitive failures within the past 4 weeks prior to filling out the questionnaire. In the present sample, a Cronbach's alpha of .90 was found, comparable to the Cronbach's alpha of .91 reported by Broadbent et al. (1982).

Digit Span Test

In the laboratory, participants were assessed with the Digit Span test (Wechsler, 1997), which is a short neuropsychological test assessing working memory attention span. Normative data derived from a Danish population sample exist for this test (Nielsen, Knudsen, & Daugbjerg, 1989).

Statistical Analysis

Statistical analyses were performed using the STATA (Stata Corp. LP, College Station, TX) and WinPEPI (Brixton Health, London, England) software packages. The data were analyzed blinded by letting an external consultant recode the grouping variable. The blinding was kept unbroken until final conclusions had been drawn on the results.

Baseline characteristics were compared using the chi-squared test of comparable distributions and Student's *t* test.

Outcome analyses were performed as intention-to-treat with mixed model univariate repeated measures analysis of variance. Model validation was performed using Bland–Altman plots, QQ plots of the residuals, and sum residual plots. Estimates are reported with 95% confidence intervals.

To enable comparison between changes on different measures, we calculated effect sizes using Cohen's *d* (J. Cohen, 1988). Calculating Cohen's *d* is a method commonly used to derive standardized mean differences on a given scale or questionnaire. It measures changes over time in terms of standard deviations from the original distribution at baseline, and is calculated as d = mean(a) – mean(b)/(pooled variance of a and b). Results are interpreted using the following guidelines: small $d < 0.5$ *SD*, medium $d = 0.5–0.8$ *SD*, and large $d > 0.8$ *SD*.

RESULTS

Baseline Characteristics

Demographic and baseline characteristics for the intervention group and the wait-list control group are presented in Table 1. No significant differences were found between the two groups at baseline.

Outcome Measures

In the present study design, the control condition was discontinued as the timeframe moved beyond 3 months after baseline. Therefore, the results from the analysis of the outcome measures fall in two parts. In the baseline to 3 months timeframe, the results from the randomized controlled trial are reported. From 3 to 9 months, the results from the follow-up study are reported.

Randomized Controlled Trial

To provide a visual presentation of the results, Figure 2 outlines changes from baseline to the 3-month measurement on quality of sleep (BNSQ), hours spent in bed per night (BNSQ), cognitive failures (CFQ), and the Digit Span test.

The results regarding quality of sleep, hours spent in bed per night, amount of cognitive failures, and working memory attention span are presented for the randomized controlled trial in Table 2. After presenting the scores at baseline for both groups, the changes in estimates from baseline to 3 months are displayed first as the 0–3 months' change in absolute numbers with a corresponding *p* value, and second as standardized mean differences, represented by Cohen's *d*.

At baseline, the two groups are comparable on all four outcomes. Looking at changes over time, different patterns emerge for the different

Table 1. Demographic and Baseline Characteristics

Characteristic	Group	
	Intervention	Wait-list control
Gender, *n* (%)		
Female	41 (80.4)	43 (84.3)
Male	10 (19.6)	8 (15.7)
Mean (range) age (years)	44 (28–61)	46 (24–58)
Referred by, *n* (%)		
General practitioner	24 (47.1)	29 (56.9)
Union	4 (7.8)	6 (11.8)
Self-referred	23 (45.1)	16 (31.4)
Sick leave		
Full	20 (39.2)	20 (39.2)
Partial	14 (27.5)	16 (31.4)
Contacted general practitioner[a], *n* (%)	49 (96.1)	50 (98.0)
Education, *n* (%)		
9 years	10 (9.8)	11 (10.8)
12 years	41 (40.2)	39 (38.2)
Higher education[b], *n* (%)		
Short (<3 years)	18 (17.6)	14 (13.7)
Medium (3, 4 years)	28 (54.9)	29 (56.9)
Long (>4 years)	5 (9.8)	7 (13.7)
Mean (range) years in workforce	18 (1–38)	17 (2–37)
Occupation (by field), *n* (%)		
Social	14 (27.5)	15 (29.4)
Health	7 (13.7)	9 (17.7)
Teaching	9 (17.7)	5 (9.8)
Administration	10 (19.6)	3 (5.9)
Other	10 (19.7)	13 (25.5)
Taking medication, *n* (%)	21 (41.2)	25 (49.0)
Taking medication for, *n* (%)		
Depression	15 (29.4)	10 (19.6)
Hypertension	2 (2.0)	5 (4.9)
Hypothyroidism	4 (3.9)	4 (3.9)

[a] As shown under "Referred by", not all participants were referred by their general practitioner. However, all but three participants had contacted their genereral practitioner about their current problems prior to being referred either by the general practitioner, the union or via self-referral, lending to the severity of their current problems. [b] Denotes the length and level of higher education that participants have completed. Higher education is defined as a vocational education (school or university degree) that qualifies one for specific occupation or occupational field.

outcomes. On the BNSQ, both groups showed significant within-group changes over time. However, the score of the intervention group improved at 3 times the rate of the wait-list control group. The difference between the amount of change in the two groups shows a significant between-groups effect size of $d = 0.64$.

Because the total score on the BNSQ is a composite measure of both quantitative and qualitative aspects of sleep, we performed subanalyses at the item level to investigate the internal consistency of the measure. In the subanalysis, we found that the scores on all items favored the intervention

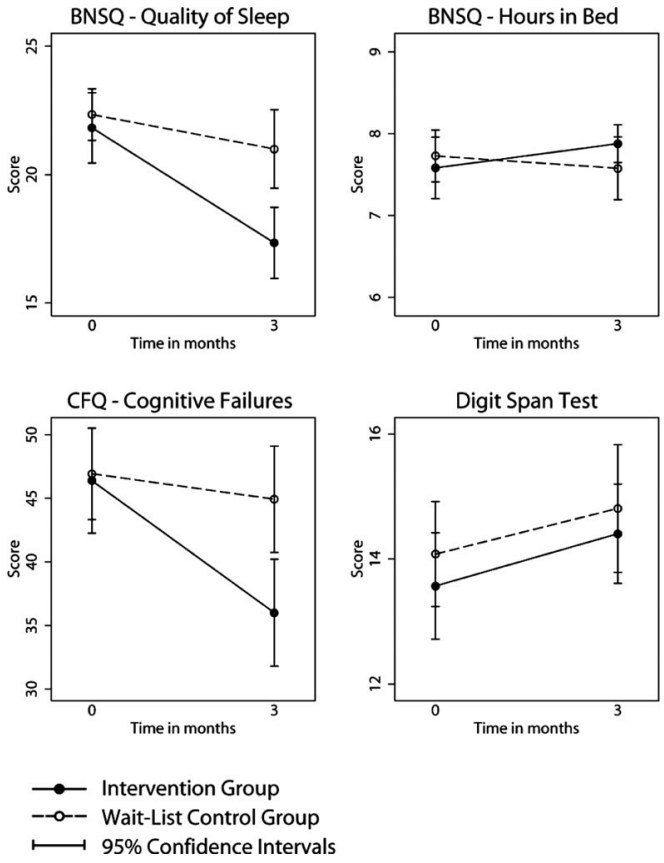

Figure 2. Changes on outcome measures from baseline (0–3 months).

over the wait-list control condition, and the combined effect of that is reflected in the total score displayed in Table 2.

Regarding number of hours spent in bed, the intervention group reported spending more time in bed, whereas the wait-list control group reported spending less time. Neither of these within-group changes, nor the between-groups difference, reached statistical significance.

On the CFQ, we found a significant within-group change in the intervention group that was roughly 5 times greater than the changes in the wait-list control group. The difference between the amount of change in the two groups shows a significant between-groups effect size of $d = 0.57$.

Finally, on the Digit Span test, we see improvements in both groups of roughly the same magnitude. As a result, the between-groups difference was very small ($d = 0.02$).

Follow-Up Study

After being put on a waiting list for 3 months, the participants in the wait-list control group were offered the stress management intervention.

Table 2. Changes Over Time From the Randomized Controlled Trial

Variable	Baseline			0–3 months changes				
	M	*SD*	95% CI	*M* change	*p*	95% CI	*d*	95% CI
Basic Nordic Sleep Questionnaire								
Intervention	21.82	4.72	[20.53, 23.12]	−4.45	.000	[−5.80, −3.11]	−0.94	[−1.23, −0.66]
Wait-list control	22.40	4.75	[21.09, 23.70]	−1.42	.041	[−2.77, −0.06]	−0.30	[−0.58, −0.01]
Intervention effect	—	—	—	−3.04	.000	[−4.95, −1.13]	−0.64	[−1.05, −0.24]
Hours in bed								
Intervention	7.58	1.13	[7.27, 7.89]	0.27	.081	[−0.03, 0.58]	0.24	[−0.03, 0.52]
Wait-list control	7.73	1.14	[7.42, 8.05]	−0.12	.441	[−0.43, 0.19]	−0.11	[−0.38, 0.17]
Intervention effect	—	—	—	0.39	.076	[−0.04, 0.83]	0.35	[−0.04, 0.74]
Cognitive Failures Questionnaire								
Intervention	46.15	13.84	[42.35, 49.95]	−9.97	.000	[−13.13, −6.81]	−0.72	[−0.95, −0.49]
Wait-list control	47.09	13.99	[43.25, 50.93]	−2.05	.219	[−5.32, 1.22]	−0.15	[−0.38, 0.09]
Intervention effect	—	—	—	−7.92	.001	[−12.47, −3.37]	−0.57	[−0.90, −0.24]
Digit Span test								
Intervention	13.57	3.14	[12.71, 14.43]	0.79	.043	[0.03, 1.56]	0.25	[0.01, 0.49]
Wait-list control	14.08	3.14	[13.22, 14.94]	0.74	.058	[−0.03, 1.50]	0.24	[−0.01, 0.48]
Intervention effect	—	—	—	0.05	.925	[−1.03, 1.13]	0.02	[−0.33, 0.36]

Note. The effect of the intervention is estimated as the between-groups difference of the changes from 0 to 3 months.

From this point, the two groups were no longer comparable in a randomized controlled design. However, the two groups were still followed independently and continued to supply information on the effect of the intervention. Table 3 shows the analysis on scores of the BNSQ, number of hours spent in bed, and scores on the CFQ and the Digit Span test in the 3- to 6-month timeframe for the intervention group as well as in the 3- to 9-month timeframe for the wait-list control group.

In the 3- to 6-month interval, no significant changes occurred within the intervention group, which was now no longer receiving treatment. On the two measures that improved significantly from baseline to 3 months (BNSQ and CFQ; see Table 2), the gains achieved were maintained at this 3-month follow-up.

From 3 to 6 months, the wait-list control group received the stress management intervention. Significant within-group changes occurred on the BNSQ ($d = 0.33$) and the CFQ ($d = 0.63$). No significant changes were observed for hours spent in bed or the Digit Span test.

Finally, in the interval from 6 to 9 months, where the wait-list control group was being followed up 3 months after termination of treatment, no significant changes occurred on any of the measures.

DISCUSSION

The results indicate that subjectively experienced quality of sleep and amount of cognitive failures can be positively affected by a stress management program. In accordance with guidelines for the interpretation of effect sizes (J. Cohen, 1988), the effect of the intervention can be labeled as medium to large for quality of sleep and cognitive failures. In the follow-up part of the trial, the effects of the intervention were maintained on both measures as the timeframe moved beyond 3 months after baseline.

Regarding the number of hours spent in bed per night, we found no differences between the two groups. The mean time spent in bed fell between 7 and 8 hr for both groups at all time points, which is within the normal human range (Kronholm et al., 2008). When juxtaposing the changes in quality of sleep with hours spent in bed, one can infer that although both groups spent approximately the same number of hours in bed, the intervention group had more potential to recuperate during those hours, given the higher quality of sleep experienced, reflecting less trouble falling asleep, fewer nightly wakings, less proneness to early morning wakenings, and less morning and daytime fatigue.

One can compare the findings from the present study with cognitive–behavior therapy for primary insomnia, originating from the field of sleep

Table 3. Scores at 3 Months and Within-Group Changes Over Time From the Follow-Up Study

	3 months		3–6 months				6–9 months			
Variable	*M*	95% CI	*M* change	*p*	95% CI	*d*	*M* change	*p*	95% CI	*d*
Basic Nordic Sleep Questionnaire										
Intervention	17.37	[16.03, 18.70]	−0.13	.853	[−1.52, 1.26]	−0.03	—	—	—	—
Wait-list control	20.98	[19.65, 22.32]	−1.58	.029	[−3.00, −0.16]	−0.33	−0.47	.546	[−2.00, 1.06]	−0.10
Hours in bed										
Intervention	7.86	[7.54, 8.18]	−0.22	.171	[−0.53, 0.09]	−0.20	—	—	—	—
Wait-list control	7.61	[7.29, 7.93]	−0.17	.299	[−0.50, 0.15]	−0.15	−0.13	.478	[−0.49, 0.22]	−0.12
Cognitive Failures Questionnaire										
Intervention	36.18	[32.32, 40.03]	−2.51	.121	[−5.70, 0.67]	−0.18	—	—	—	—
Wait-list control	45.04	[41.14, 48.93]	−8.95	.000	[−12.32, −5.59]	−0.63	0.00	.998	[−3.36, 3.36]	0.00
Digit Span										
Intervention	14.36	[13.47, 15.25]	0.05	.909	[−0.75, 0.84]	0.01	—	—	—	—
Wait-list control	14.82	[13.93, 15.71]	0.21	.605	[−0.60, 1.02]	0.07	−0.11	.796	[−0.96, 0.74]	−0.04

research. In the present study, where symptoms of insomnia were comorbid with a wider range of symptoms associated with work-related stress, the stress management intervention provided reliable changes on measures of subjective sleep quality, although the intervention did not target sleep problems extensively.

On the Digit Span test, we observed no differences between the intervention and wait-list control condition. Within both groups, we found a rise over time in the participants' scores. This rise was in all probability a test–retest effect, which is commonly found in repeated neuropsychological testing (Lezak, 1995). When compared with the normative data from a Danish sample (Nielsen et al., 1989), scores on the Digit Span test are slightly above the sample means. There is no indication that participants in the present sample could not belong to the general population regarding working memory attention span. With the limited evidence presented here, there is no reason to assume that more fundamental neuropsychological impairments in working memory attention span have been sustained by the participants as a result of their prolonged stress reaction.

As mentioned in the introduction, impairment in cognitive performance measured by neuropsychological tests has been associated with chronic stress (Sandström et al., 2005). In the present context, participants had a stress reaction for up to 6 months, but participants with chronic stress conditions (i.e., more than 26 consecutive weeks of sick leave) were not included. This difference in sampling could account for some of the difference in the findings regarding cognitive impairment measured by neuropsychological testing.

Whether the Digit Span test is an appropriate measure of cognitive functioning can be debated. It was originally included in the study to obtain an objective measure of cognitive functioning to contrast the self-report data obtained with the CFQ. Methodological concerns in terms of practicability and feasibility also played a role in the selection of this measure. On the other hand, it may be too simple a tool to properly tap the complexities of the full scope of human memory and attention.

Limitations

The wait-list control design imposes limitations regarding the conclusions one can draw compared with a conventional controlled design. Letting the wait-list control group cross over and receive the treatment has been an ethical and logistical consideration in attempting to ensure a high degree of motivation in the control group while still maintaining a partially controlled design. It was feared that participants randomized to a control condition

throughout the trial would have low motivation to continue participating after their allocation or be prone to seek help elsewhere while acting as controls.

Apart from its practical and logistical considerations, it can be argued that the wait-list control design does offer an opportunity to investigate whether the effect of the intervention can be replicated in the wait-list control group when offered the intervention 3–6 months after baseline. The intervention effect on the two outcome measures in the randomized controlled part of the study, quality of sleep and cognitive failures, was mimicked when the wait-list control group received the intervention 3–6 months after baseline, as seen in Table 3.

The use of self-report data to assess sleep and everyday cognitive failures is a limitation of the current study, and may potentially reduce the weight of the conclusions one can draw. In an intervention trial, self-report data are vulnerable to participants' expectations of change rather than actual change. Also, in sleep research, objective and subjective measures of sleep are not always highly correlated. However, in a study by Ekstedt et al. (2006), patients suffering from severe occupational burnout had poorer quality of sleep on subjective and objective measures of sleep, but there may be differences between the study population assessed by Ekstedt et al. and our study population.

Relying mainly on self-report data highlights the emphasis we have put on a clinical practice perspective rather than a basic laboratory approach. As pointed out above, the subjective improvement in sleep and cognitive ability reported by the participants after the intervention, may not necessarily be reflected in an actual improvement in sleep if measured in the laboratory. However, from a clinical perspective, the subjective experience of better sleep and cognitive ability may positively affect participants' perception of their own work ability, and thus may promote actively managing their work situation.

We do not regard subjective and objective measures of sleep or cognitive ability as mutually exclusive. In future studies, we recommend that subjective measures of sleep and cognitive failures be used in conjunction with objective measures to further understanding of their interconnection.

Comparisons and Evaluation of Findings

To our knowledge, no previous studies have investigated the effect of a stress management intervention on sleep and cognition. However, a number of studies have investigated the connection between stress and either sleep or impairment in cognitive ability.

A strong association has been found between psychosocial strain experienced at work and poor quality of sleep (Eriksen, Bjorvatn, Bruusgaard, &

Knardahl, 2008; Knudsen, Ducharme, & Roman, 2007; Kudielka et al., 2004). In the light of these findings, we propose that the stress management intervention is effective in lowering the perceived psychosocial work strain and improves the quality of sleep experienced.

Work stress has been associated with cognitive failures (Mahoney et al., 1998; Van Der Linden et al., 2005). In a similar fashion to the argument made on stress and sleep, we propose that lowering the participants' stress through a stress management intervention also lowers the amount of cognitive failures.

In terms of clinical relevance, the findings from the present study point to the stress management intervention's impact on areas critical for performing at work. Occupational injuries (Akerstedt, Fredlund, Gillberg, & Jansson, 2002) and loss in productivity (Ricci, Chee, Lorandeau, & Berger, 2007) have been associated with fatigue and poor quality of sleep. Poor sleep and fatigue have also been associated with long-term sick leave absence (Akerstedt et al., 2007), which is a burden on organizations and society that has been increasingly reported in countries across the European Union in recent years (Borg et al., 2000). In this light, an intervention that improves quality of sleep, reduces fatigue, and improves everyday cognitive performance is an asset for both the individual and the employing organization.

Conclusion

In conclusion, this study has shown that the stress management intervention has a medium effect on improving self-reported quality of sleep and reducing reports of everyday cognitive failures when compared with a wait-list control condition. The gains achieved during the intervention were maintained at 3-month follow-up. Hours spent in bed per night and working memory attention span were within normal ranges and were not affected by the intervention.

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C Paper III

Biological markers of stress: results from a randomized wait-list controlled trial of a stress management intervention

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Abstract

Background: The concept of stress has been operationalized both psychologically, as perceived stress, and biologically, as heightened activity of the hypothalamic-pituitary-adrenal (HPA) axis. In a stress management intervention study for work-related stress defined in psychological terms, biological markers of heightened HPA axis activity were investigated.

Methods: 102 participants with elevated levels of stress were randomly allocated to a three-month stress management program or a wait-list control group. Outcomes were biological markers (biomarkers) of stress, measured at baseline and three months, including blood pressure and resting pulse, as well as serum concentrations of cortisol, triglycerid, cholesterol (HDL, LDL), Haemoglobin A_{1C} and thyreotropin..

Results: At baseline the Intervention and Wait-list control groups were comparable and levels of biomarkers were within clinical and laboratory reference levels. Regarding changes from baseline to three months follow-up no systematic within-group differences were found (p=0.01–0.93). No between-group differences were found when comparing the changes over time in the two groups (p=0.17–0.93).

Conclusions: Participants did not exhibit extreme baseline levels on biomarkers of stress. Biomarker levels were not susceptible to change as a result of the intervention.

Background

The link between stress and health has been a controversial issue in the scientific literature for decades. In an attempt to integrate the different perspectives, the relationship between stress and disease can be defined as a process in which "environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place persons at risk for disease" [1, p. 3].
The biological changes that may occur in the organism, when reacting to a stressor, can be described by processes related to the hypothalamic-pituitary-adrenal (HPA) axis.

In the field of occupational medicine much focus has been given to epidemiological studies that investigate whether work demands that exceed the adaptive capacity of the individual, may result in biological changes that place the person at risk for disease. The diseases most widely investigated in relation to job strain are depression [2, 3], heart disease [4, 5], hypertension [6–8] and the metabolic syndrome [9, 10].
No consensus has been reached on which biological markers (biomarkers) one should measure in order to investigate the relation between environment, stress and disease. However, a number of biomarkers have received increased attention, among these cortisol (depression), triglycerid and cholesterol (heart disease), blood pressure (hypertension) and Haemoglobin A_{1C} (metabolic syndrome). According to a recent comprehensive review by Hansen et al. [11], studies of biomarkers such as cortisol and cholesterol show both positive and negative associations to the working environment, weakening their status as robust biomarkers, despite their widespread use in research and close link to the HPA axis. Haemoglobin A_{1C} was in the same review found to be a more robust biomarker of stress, with seven out of seven studies showing a positive association to the working environment.
Following from the review by Hansen et al. [11] many epidemiological studies of biomarkers for stress in relation to the working environment are cross-sectional (30 out of 51 studies) and we find that the extent to which they measure acute versus chronic stress reactions is not always clear.
The current study wishes to expand on the epidemiological studies presented above, to a clinical epidemiological perspective where we investigate if a psychological intervention can affect the possible relationship between work, biomarkers, and stress.

In clinical trials investigating interventions that target work-related stress relatively little attention has been given to biomarkers of stress. Typically such trials focus more on measures of psychological well-being and absenteeism. Two studies have been found that measure changes in biological markers of stress resulting from a stress management intervention. Nickel et al. [12] found that the intervention significantly

reduced daily systolic blood pressure and salivary cortisol in men with elevated, chronic occupational stress. In another study by McCraty et al. [13] the intervention produced clinically significant changes in blood pressure among hypertensive employees (72% male participants).

In a clinical trial investigating the effects of a three-month psychological stress management intervention participants underwent an ambulatory physical examination and had a blood sample drawn. Through analysis of the collected data we wish to investigate the baseline levels of the selected stress-related biomarkers, compared to clinical and laboratory reference levels. Secondly we wish to investigate whether the intervention, within a randomized wait-list controlled design, has an impact on biomarker levels.

Methods

Design and Time Frame

A randomized wait-list control design was used in this study (fig. 1). After their baseline measurement participants were randomized to either the Intervention group or to a Wait-List Control group. After being on the wait-list for three months, the Wait-list Control group received the intervention as well. Outcome variables were measured at baseline and at 3 months follow-up.
For details on sample size estimation, see Willert et al. [14].
Inclusion took place over a period of 10 months from December 2006 through September 2007, with groups commencing in succession from January–December 2007.

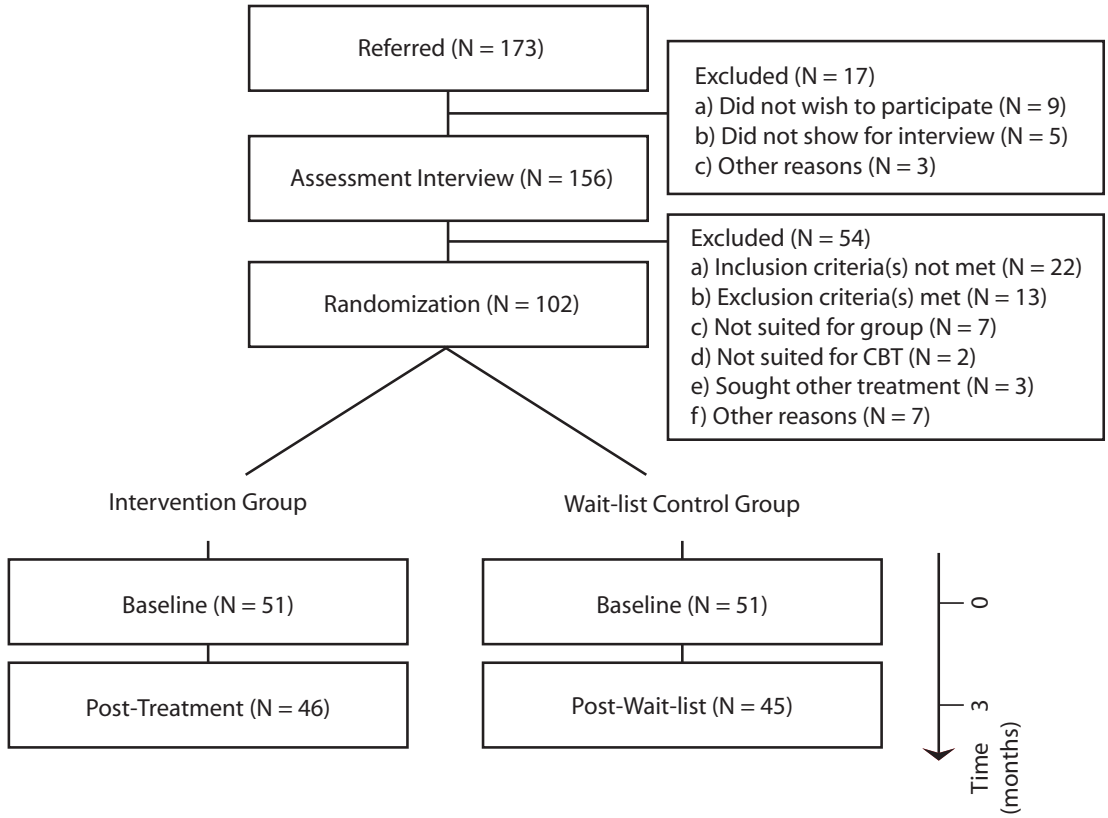
Ethics

The research protocol for this study complies with the Declaration of Helsinki and was approved by The Ethics Committee for Aarhus County, now The Ethics Committee for Region Midt, prior to inclusion of participants. All potential participants were informed about the implications of participation and their rights as participants in a biomedical research project, following the guidelines of The Danish National Committee for Biomedical Research Ethics, and signed a written consent form before inclusion to the study.

Referral

Persons from the working population (18-67 years) in the municipality of Aarhus and its surrounding communities could participate in the study. Referral was available for local GP's, union social workers, and through direct inquiry.

Figure 1: Flowchart of participants' progress through the phases of the trial.



In total 173 persons were referred to participate, as illustrated in fig. 1. Out of this group 156 persons were invited to an assessment interview to determine eligibility, while 17 potential participants were excluded (see fig. 1 for reasons). From the assessment interview 102 persons were invited and accepted to participate, while 54 persons were not included (see fig. 1).

Assessment and eligibility

Potential participants were given a semi-structured assessment interview by a clinical psychologist (>5 years training).

Inclusion criteria were persistent symptoms of work-related stress, defined by physiological and psychological symptoms of sustained arousal lasting more than 4 weeks and elevated reactivity of symptoms to demands at work. Motivation to remain employed and, if on sick leave, a planned return to work within 4 weeks was required. Participants were either on sick leave through assessment by their GP, or working. For the latter, a score of 20 points or above on the Perceived Stress Scale was required (equaling one standard deviation above the population mean reported by Cohen & Williamson [15]).

Exclusion criteria were more than 26 consecutive weeks of sick leave ; substantial psycho-social strains outside of work; bullying as the main problem; severe psychiatric condition or a history of repeated psychiatric conditions, and current abuse of alcohol or psychoactive stimulants.

Allocation

Upon completing the baseline measurement an envelope containing the participants allocation was opened by an independent person. After randomization a total of 51 participants comprised the Wait-List Control group, while 51 participants made up the Intervention group. In the first three months after baseline 10 participants dropped out of the study (fig. 1).

Intervention

Each group held nine participants, encompassed 8 three-hour sessions over a period of three months and was was led by one of two experienced clinical psychologists. For a more detailed account of the focus of the intervention, see [14].

Laboratory procedures

For each data collection participants were examined at the laboratory of the Department of Occupational Medicine at the University Hospital of Aarhus. The laboratory technician associated with the study began each examination by asking participants about current known medical illnesses and use of prescribed medication. Next participants had a blood sample drawn and were then allowed to rest for 5 minutes in the supine position. Before the resting period an electronic sphygmomanometer (Omron M6 Comfort) was fitted on the participants left arm. After the resting period the automated measurement was initiated by the laboratory technician and the read out of the sphygmomanometer was recorded. Blood samples were sent to the hospital laboratory for analysis on the same day, and were analyzed on COBAS 6000 and VARIANT equipment. Procedures in the laboratory comply with DANAK-certification regulations.

Outcome Measures

From the physical examination blood pressure and resting pulse were measured, to asses adrenergic processes. Blood samples were analyzed with regards to catabolic processes by measuring the levels of cortisol. Metabolic processes were assessed by measuring the levels of triglycerid and cholesterol (including low-density lipo-protein associated cholesterol (LDL) and high-density lipo-protein associated cholesterol (HDL).

Analysis of circulating levels of glucose in the bloodstream was assessed by measuring Haemoglobin A_{1C} levels. Thyroidea function was evaluated by analysis of the hormone thyreotropin.

Monitoring test results

All test results were monitored as data were gathered in the laboratory and as results from the blood samples were analyzed. If participants had a systolic blood pressure above 140 mm Hg, or a diastolic blood pressure above 90 mm Hg, they would first be allowed a 15 minutes rest, after which a new measurement would be taken. If blood pressure was still above the mentioned limits, participants were advised to consult their general practitioner for relevant steps to be taken. If biomarker levels outside of the laboratory reference levels were found, the participant was contacted and recommended to contact their general practitioner.

Statistical Analysis

Statistical analyses were performed using the STATA (Stata Corp LP, College Station, TX, USA) software package.

Baseline characteristics were compared using the chi-squared test of comparable distributions and the student's t-test.

For logistic reasons data were collected in the laboratory in the time span between 0800h and 1400h. To correct for the possible time dependency of the measured outcomes, all test results were calibrated to an adjusted 0800h level.

Outcome analyses were performed with the student's t-test. Model validation was performed using histograms, QQ-plots and box-and-whiskers plots, and by testing for comparable variances in the two groups (variance-ratio test). Results are reported with 95% confidence intervals.

Results and Discussion

Baseline characteristics

Demographic and baseline characteristics for the Intervention group and the Wait-List Control group are presented in Table 1. No significant differences were found between the two groups at baseline. Almost all participants had contacted their general practitioner (GP) prior to inclusion in the study. Seven participants were taking hypertensive medication at inclusion.

Outcome Measures

In Table 2 baseline scores and changes over time from baseline to three months follow-up on blood pressure and resting pulse are presented.

Secondary analyses of systolic and diastolic blood pressure revealed that exclusion of a single outlier in the I-group, with very low measured blood pressure at baseline (81/47 mm Hg), made the changes over time in the two groups almost identical, raising the p-value of the test for an intervention effect to $p>0.80$ for both systolic and diastolic blood pressure (data not shown). Excluding those taking hypertensive medication at baseline (n=7) from the analysis, did not change the results either (data not shown).

Baseline scores and changes over time for outcome measures derived from blood samples are presented in Table 3.

With regards to triglycerid and thyreotropin the baseline scores on these measures do not fulfill criteria for normal distribution. However, the changes from baseline to three months can be accepted as normally

Table 1: Demographic and baseline characteristics.

Characteristic		*Intervention*		*Wait-list control*	
Gender	Female	41	(80.4%)	43	(84.3%)
	Male	10	(19.6%)	8	(15.7%)
Age (mean, range)		44	(28–61)	46	(24–58)
Referred by	GP	24	(47.1%)	29	(56.9%)
	Union	4	(7.8%)	6	(11.8%)
	Phone	23	(45.1%)	16	(31.4%)
Contacted GP		49	(96.1%)	50	(98.0%)
School Education	9 years	10	(9.8%)	11	(10.8%)
	12 years	41	(40.2%)	39	(38.2%)
Further Education	Short (<3 y)	18	(17.6%)	14	(13.7%)
	Medium (3–4 y)	28	(54.9%)	29	(56.9%)
	Long (>4 y)	5	(9.8%)	7	(13.7%)
Years in workforce		18	(1–38)	17	(2–37)
Occupation (by field)	Social	14	(27.5%)	15	(29.4%)
	Health	7	(13.7%)	9	(17.7%)
	Teaching	9	(17.7%)	5	(9.8%)
	Administration	10	(19.6%)	3	(5.9%)
	Other	10	(19.7%)	13	(25.5%)
Taking medication		21	(41.2%)	25	(49.0%)
Medication (by type)	Anti-depressive	15	(29.4%)	10	(19.6%)
	Hypertensive	2	(2.0%)	5	(4.9%)
	Hypothyroidism	4	(3.9%)	4	(3.9%)

Table 2: Blood pressure and resting pulse baseline mean scores and changes over time.

	Baseline	SD	0–3 months	95% CI[†]	p-value
Systolic blood pressure (mm Hg)					
Intervention	118.00	15.8	-2.73	-6.25 – 0.78	0.12
Wait-list control	120.79	16.5	-3.60	-6.88 – -0.32	0.03
Intervention effect	.	.	0.87	-3.87 – 5.61	0.72
Diastolic blood pressure (mm Hg)					
Intervention	76.20	10.33	-1.42	-3.89 – 1.04	0.25
Wait-list control	78.22	11.63	-1.71	-4.56 – 1.13	0.23
Intervention effect	.	.	0.29	-3.44 – 4.01	0.88
Resting pulse (beats/min)					
Intervention	64.79	9.76	-1.49	-3.71 – 0.74	0.18
Wait-list control	65.44	11.74	-1.34	-3.90 – 1.22	0.30
Intervention effect	.	.	-0.15	-3.50 – 3.20	0.93

[†] 95% Confidence Intervals

Table 3: Biomarker baseline mean scores and changes over time.

	Baseline	SD	0–3 months	95% CI[†]	p-value
Cortisol (nmol/l, 200–700[a])					
Intervention	497.20	98.30	-23.80	-63.10 – 15.50	0.23
Wait-list control	503.79	118.77	-42.88	-81.77 – -4.00	0.03
Intervention effect	.	.	19.08	-35.44 – 73.61	0.49
Triglycerid (mmol/l, <2.5[a])					
Intervention	0.23	0.53	0.10	-0.09 – 0.29	0.28
Wait-list control	0.09	0.44	0.07	-0.07 – 0.20	0.33
Intervention effect	.	.	0.03	-0.19 – 0.26	0.76
Cholesterol, total (mmol/l, <6.0[a])					
Intervention	5.48	0.90	-0.05	-0.23 – 0.12	0.54
Wait-list control	5.10	0.86	-0.08	-0.28 – 0.12	0.44
Intervention effect	.	.	0.02	-0.24 – 0.29	0.86
Cholesterol, HDL (mmol/l, >0.9[a])					
Intervention	1.72	0.51	-0.08	-0.14 – -0.01	0.02
Wait-list control	1.75	0.54	-0.08	-0.14 – -0.02	0.01
Intervention effect	.	.	0.00	-0.08 – 0.09	0.92
Cholesterol, LDL (mmol/l, <4.5[a])					
Intervention	3.11	0.72	0.01	-0.15 – 0.17	0.93
Wait-list control	2.80	0.76	-0.02	-0.20 – 0.15	0.79
Intervention effect	.	.	0.03	-0.20 – 0.26	0.80
Haemoglobin A_{1C} (%, 5.1–6.2[a])					
Intervention	5.53	0.42	0.00	-0.08 – 0.07	0.89
Wait-list control	5.62	0.69	0.01	-0.08 – 0.06	0.78
Intervention effect	.	.	0.00	-0.09 – 0.10	0.92
Thyreotropin (miu/l, 0.1–4.0[a])					
Intervention	0.06	1.19	0.26	0.00 – 0.51	0.04
Wait-list control	0.31	0.74	0.02	-0.22 – 0.26	0.88
Intervention effect	.	.	0.24	-0.11 – 0.58	0.17

[†] 95% Confidence Intervals

[a] Laboratory reference levels

distributed, and it was thus possible to perform statistical analyses using parametric statistical methods. An analysis of differences in baseline levels between completers (n=91) and non-completers (n=11) was conducted on all outcome measures (data not shown). The analysis revealed a tendency for non-completers to have higher blood pressure and resting pulse compared to completers, all though these differences were not statistically significant.

Discussion

We have found that baseline levels of the selected outcomes are within clinical and laboratory reference levels. No systematic within-group changes over time for the Intervention and Wait-list control groups were observed. No between-group differences in the changes over time of the two groups were observed on any outcome measure.

Comparison of baseline measures between completers and non-completers could not account for the lack of significant results, all though a trend was found, where non-completers had higher blood pressure and resting pulse, than completers. This could potentially induce selection-bias in the results. However, no other measures investigated exhibited this difference, weakening the potential overall effects of drop-out from the study.

The average blood pressure found is close to the danish national guidelines for mean normal blood pressure of 120/80 mm Hg. Looking at the standard deviations on the blood pressure means for both groups, we find that roughly 85% of the participants have a systolic blood pressure below 135 mm Hg, which according to danish national guidelines is the limit between normal and elevated blood pressure.

Only for the measures of cholesterol and Haemoglobin A_{1C} could reference intervals be found from a study of a small danish sample of healthy workers [16]. On total cholesterol the observed values in the present study were well within the reference interval of 3.52–7.86 mmol/l, while Hemoglobin A_{1C} was close to the upper limit in the reference interval ranging from 3.4–5.60%. However, a comparison of this kind must remain tentative in the present context, since both samples are relatively small and differences in a range of factors such as age, sex, occupation, etc. may exist between the present study population and the reference population.

Limitations of the study includes the sampling methods used. Blood pressure was taken in a single measurement, but could optimally have been backed up by a second measurement, using the mean of these two measurements as the final result.

Blood samples were, due to logistic reasons, drawn between 0800h and 1400h, and later corrected to an adjusted 0800h level. This correction procedure was decided a priori, but when assessing the time-dependency of the different measures, it may only have been necessary for one outcome, cortisol, which displayed a clear time trend, when plotting cortisol measurement values against sampling hour.
A potential source of bias is introduced by the laboratory procedure of referring participants to consult with their general practitioner, if their biomarker levels were above clinical guidelines or laboratory reference levels. In terms of ensuring optimum patient health and following ethical guidelines for bio-medical research, this procedure makes absolute sense. However, in a clinical trial of the efficacy of a given intervention, the procedure may introduce confounders that undermine the possibility of observing an effect of the intervention under investigation.

Compared to the two earlier studies identified, the present results diverge from the previous findings. Nickel et al. [12] found that a group based stress management intervention reduced daily systolic blood pressure and salivary cortisol in a sample of workers with work-related stress due to overworking. At baseline participants in the Nickel et.al. study had an elevated mean systolic blood pressure of 144 mm Hg. An obvious difference between ours and this study is the sample population. In the Nickel et.al. study all participants were male, where our study sample was more than 80% female.
In the study by McCraty et al. [13] the intervention produced a reduction in blood pressure among hypertensive employees. Once again there is a difference in the sample population; McCraty et.al.'s study sample is 72% male. Furthermore, McCraty et.al. investigate the effect of the intervention on participants that are hypertensive at baseline, with a mean systolic blood pressure of 129 mm Hg.
In our study population of 80% female workers, with no selection on hypertension, we do not see an effect on biomarker levels from a group based psychological stress management intervention, as found by previous studies.
It is remarkable that the two identified previous studies both have predominantly male study samples, while the stress management literature as a whole includes many studies with predominantly female study samples. This lack of studies on biomarkers in female study samples could be attributable to publication bias. It is also possible that it reflects a more fundamental difference in the the course and symptoms of (work-related) stress reactions for men and women, as proposed by Taylor et al. [17].

In a clinical context the results do not support the hypothesis that participants with psychologically defined clinical levels of long-lasting work-related stress, have corresponding extreme values of biological

markers of stress.

However, the course of an episode of work-related stress often spans several months. The majority of participants in the current study had been on sick leave for a number of months, and an inclusion criteria for participation in the study, was a planned return to work within four weeks from the assessment interview. This means that the acute work-related stress episode, that lead these participants to enter a period of sick leave, lay several months in the past.

The course of respectively psychologically and biologically defined stress with a typical work-related stress episode, has not been mapped out. What we see from the current study, is that they do not necessarily follow one another in intensity over time, in the later stages of a work-related stress episode.

Conclusions

In conclusion we have found that the study sample on a group level did not exhibit extreme baseline levels of the investigated biological markers of stress. Secondly, the investigated biomarker levels were not susceptible to change as a result of the intervention.

Competing interests

The authors have no financial or other relationships that may lead to a conflict of interest.

Authors' contributions

Morten Vejs Willert is the principal author on the manuscript and has been employed as project manager of the trial. Ane Marie Thulstrup has supervised the execution of the trial and has given feedback and monitored the consecutive revisions of the manuscript closely. Jens Peter Bonde has given feedback on key revisions of the manuscript, including the final draft.

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D Paper IV

Original article

Scand J Work Environ Health – online first

Effects of a stress management intervention on absenteeism and return to work – results from a randomized wait-list controlled trial

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Objectives High levels of work-related stress are associated with increased absenteeism from work and reduced work ability. In this study, we investigated the effects of a stress management intervention on absenteeism and return to work.

Methods We randomized 102 participants into either the intervention or wait-list control (WLC) group. The intervention group received the intervention in weeks 1–16 from baseline, and the WLC group received the intervention in weeks 17–32. Self-reported data on absenteeism (number of days full- or part-time absent from work within the previous three months) were obtained at 16, 32, and 48 weeks follow-up. Register-based data on long-term absence from work were drawn from the Danish public transfer payments (DREAM) database from baseline and 48 weeks onwards. The DREAM database contains weekly information on long-term sickness absence compensation. The threshold to enter DREAM is sick leave for two consecutive weeks.

Results At follow-up in week 16, self-reported absenteeism in the intervention group [median 11 days (range 3–25)] was lower (P=0.02) than in the WLC group [median 45 days (range 19–60)], corresponding to a 29% [95% confidence interval (95% CI) 5–52] reduction. On register-based data (cumulated weeks in DREAM, weeks 1–16), the intervention group median [6 weeks (range 0–11)] was lower than that of the WLC group [median 12 weeks (range 8–16)], though not significantly (P=0.06), corresponding to a 21% (95% CI 0–42) reduction. For return to work, a hazard ratio of 1.58 (95% CI 0.89–2.81) favoring the intervention group was found (P=0.12).

Conclusions The intervention reduces self-reported absenteeism from work. A similar trend was found from register-based records. No conclusive evidence was found for return to work.

Key terms job; occupational medicine; RTW; sick leave.

Absenteeism from work has been associated with concurrent increasing levels of work-related stress in European countries (1) and is a global measure of workers health (2). Evidence on the prevention of work disability from mental health problems is scarce. In three recent Cochrane reviews (3–5), only two studies targeted work ability directly (6, 7).

Cognitive behavioral stress management interventions often use only psychological outcomes (8–10). In a recent review, 4 out of 36 studies used absenteeism as an end-point; none of these used a cognitive behavioral approach (8). As pointed out by de Vente et al (11) the majority of previous studies targeted non-clinical samples. An exception to this is a string of Dutch studies (6, 11–15), of which three studies are relevant to the present study.

In a study by de Vente et al (11), contrary to the authors' hypothesis, individual- and group-format cognitive behavioral stress management intervention led to more days absent compared to care-as-usual. Workers (N=82) on >2 weeks of sick leave, with no selection on occupation, were included.

Studies by both Klink et al (12) and Blonk et al (6) have demonstrated an effect on absenteeism by approaches based on a cognitive behavioral rationale and pre-structured graded activity time schemes. The Klink et al study (12) included postal company workers (N=192) on their first sick leave, while Blonk et al (6) included self-employed people (N=122) on sick leave.

In our study, we conceptualized work-related stress as the experience of intense negative cognitions,

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emotions, and physical sensations in relation to repeated critical situations at work, typically involving perceived demands that one is not able to meet (16), and negative expectancies of coping with future situations (17).

An inherent limitation in studies of work ability and absenteeism from work are differences in the legislation governing the labor market of individual countries. This weakens comparability of studies across countries. In Denmark, sick leave extending beyond two weeks must be sanctioned by the worker's general practitioner. Workers are permitted sick leave for ≤52 consecutive weeks with full compensation.

It has been discussed how to measure absenteeism from work and return to work (18) – and which method (ie, using self-report or register-based data) is preferred (19). Young et al (18) note that no consensus on the appropriate outcomes of return-to-work interventions exists; they advocate a multidimensional approach. Pole et al (19) suggest that researchers should carefully consider the most appropriate measure in the context of a particular study, potentially collecting both self-report and register-based data. From the Whitehall study, Ferrie et al (20) found good agreement between self-reported data and employers' registers of sickness absence.

Numerous ways of assessing absenteeism have been proposed, including (i) incidence; (ii) cumulative duration from ≥1 absence spells; (iii) time until first, or lasting return to work; and (iv) time until first recurrence of sickness absence (4, 21). As a measure of absenteeism from work, we have used cumulative duration from ≥1 absence spells, since this measure is not dependent on whether or not participants were on sick leave at the time of inclusion in the study and could be measured using both self-report and register-based data. Furthermore, for those on sick leave at inclusion, we looked at time until lasting return to work. For those not on sick leave at inclusion, we looked at time until first incidence of sick leave.

The intervention was directed at workers that were either at risk of going on sick leave or returning from a period of sick leave – returning from sick leave is a transition often feared due to the renewed exposure to work. In one recent study, fear-avoidance beliefs about work were the most important risk factor for not returning to work among workers on long-term sick leave (22). Workers typically fear not being able to cope with work, the subsequent reappearance of their symptoms, and risk of renewed sick leave. Both for those returning to work and those already active at the workplace, the goal of the intervention was to improve the ability to cope with experienced demands at work and reduce the need for sick leave to cope with the situation. We expected the effects of the intervention to take place either from the onset of the group sessions, through the perceived help and support offered, or alternatively following the first four weekly sessions, where most of the intervention tools were introduced. Our expectation for change earlier rather than late in the stress management intervention, was adapted from the literature on the effects of psychological interventions, where the most rapid changes in symptom relief appear in the earlier phases of treatment (23).

The objectives of this study fall in two parts. In hypothesis 1, we examine if a group-format cognitive behavioral stress management intervention reduces absenteeism from work, measured as cumulative duration of sickness absence from ≥1 absence spells. In hypothesis 2, we examine (i) if the intervention shortens the time to lasting return to work for those on sick leave at the time of inclusion in the study and (ii) whether the intervention reduces incidence of new spells of sick leave for those working at inclusion.

Methods

Study design

The study used a randomized wait-list control design (figure 1). Participants were randomized to either the intervention group or to a wait-list control (WLC) group, after their baseline measurement. After three months on the wait-list, the WLC group also received the intervention. Participants in the WLC condition were not hindered in seeking supplementary help while on the wait-list, nor were the participants hindered from seeking help upon completion of the treatment.

Follow-up from baseline was 48 weeks. Questionnaires were obtained at 16, 32, and 48 weeks. Register-based data on long-term sick leave were drawn from baseline and 48 weeks onwards.

Sample size and inclusion period

An a priori power calculation, based on one of the main outcome measures of the study [ie, the Perceived Stress Scale (PSS)], estimated the necessary sample size to be 90 participants. This would allow for detection of a between-groups difference of one standard deviation (SD) from the score at baseline (24, 25). The sample size calculation was based on significance level: 95%, power: 80%, SD: 5, intra-class correlation coefficient: 0.15, and average cluster size: 9. To allow for a 10% dropout, 102 participants were included. At the time of performing the power calculation, the estimated sample size was considered adequate for all outcome measures included.

Induction into the study took place over a period of ten months, from December 2006 through September 2007, with groups commencing in succession from January–December 2007.

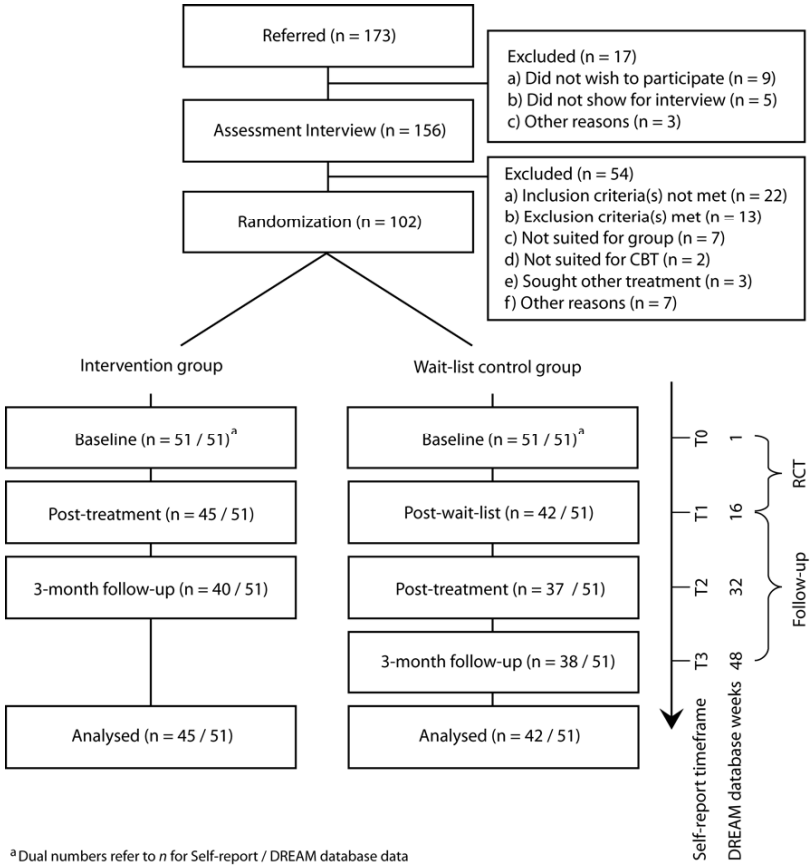


Figure 1. Flowchart of participants' progress through the phases of the trial.

Referral

Persons from the working population (18–67 years) in the municipality of Aarhus could participate in the study. Referral was available through local general practitioners, union social workers, and direct inquiry.

In total, 173 persons were referred to participate, as illustrated in figure 1. Out of this group, 156 persons were invited to an assessment interview to determine eligibility, while 17 persons were excluded (see figure 1 for reasons). From the assessment interview, 102 persons were invited and accepted to participate, while 54 persons were not included. All persons not included were informed about alternatives.

Assessment and eligibility

A clinical psychologist (>5 years training) undertook a semi-structured assessment interview with potential participants. Inclusion criteria included persistent symptoms of work-related stress, defined by physiological and psychological symptoms of sustained animation, lasting >4 weeks, and elevated reactivity of symptoms to demands at work. Motivation to remain employed and, if on sick leave, a planned return to work ≤4 weeks was required in order to comply with the intervention rationale of homework assignments between group sessions, applying the techniques learned in groups at work. Participants were either on sick leave following an assessment by their general practitioner or working. For the latter, a score of ≥20 points on the PSS was required [equaling 1.0 SD above the population mean reported by Cohen & Williamson (25)].

Exclusion criteria were: (i) >26 consecutive weeks of sick leave (to select individuals recently active at their workplace and deselect those at risk of falling under social service regulations); (ii) substantial psychosocial strains outside of work; (iii) bullying as the main problem; (iv) severe psychiatric condition or a history of repeated psychiatric conditions; and (v) current abuse of alcohol or psychoactive stimulants.

Allocation

The study used block randomization in blocks of six, generated using the RANNOR computer algorithm (SAS Inc, Cary, NC, USA). After the baseline measurement, an independent individual open the envelopes containing the participants' allocation. After randomization, the intervention and WLC groups each comprised 51 participants. At the first measurement after baseline, 15 participants did not complete their follow-up measurement (figure 1).

Intervention

Each group contained nine participants, encompassed eight 3-hour sessions over a period of three months and was led by one of two licensed clinical psychologists, with >5 years of clinical experience and a 1-year advanced training course in cognitive behavior therapy. Groups met for weekly sessions the first four weeks, and then every fortnight for the remaining four sessions. Treatment was manualized, and used a slide show to set the agenda for each group session, promoting uniform delivery of the intervention between groups.

A goal of the intervention was to enable the participants to cope with stressful situations at their workplace and strengthen their ability to be active at work, despite their current difficulties. This goal was underpinned by the content of the group sessions, the main topics of which were: (i) introduction to cognitive behavior therapy, (ii) psychoeducation on stress, (iii) identifying dysfunctional thinking, (iv) modifying dysfunctional thinking, (v) communication and stress, (vi) communication skills training, (vii) implementing strategies at work, and (viii) review of techniques. Between group sessions, participants completed homework assignments aimed at promoting implementation of the techniques learned in the groups at work.

Outcome measures

Two independent measures of absenteeism from work were used: one measure was a self-reported questionnaire, the other comprised data from a national database of public transfer payments. The two measures represent overlapping, but not identical time periods during follow-up. The self-reported data consist of information on three-month periods in retrospect at three follow-up points that are four months apart, while the register-based data consist of continuous week-by-week registrations in three follow-up periods of 16 weeks each.

Self-reported data

At follow-up measurements, participants reported in a questionnaire their amount of days on full or partial sick leave in the preceding three months. There where two questions covering this dimension, voiced as follows: "How many full working days have you been on sick leave from your work in the last three months?" and "How many days have you been working reduced hours in the last three months?" After each question, there was space for the participant to fill in the number of days. The number of days reported for each question was added to give a single measure of full or partial sick leave from work, which allows for comparability with the register-based data.

The DREAM database

In Denmark, 102 types of public transfer payment to Danish citizens have been registered week-by-week in a national registry since 1991 (the so-called DREAM database). Once registered in the database, it is possible to change the type of transfer payment registered between the major types of registrations (eg, "full sick leave" to "unemployment"). A limitation of the database is that changes within the "family" of sick leave registrations (eg, full and partial sick leave) cannot be distinguished within the same period of sickness absence. Termination of registration occurs following the first full week of not receiving any type of transfer payment.

Data on registrations in the DREAM database were obtained from each participant's date of randomization and 52 weeks ahead, as well as back in time.

When investigating the mean number of weeks between measurements on self-reported data, it turned out that the three-months intervals between measurements appointed by the research protocol, was in fact on average four months due to logistic and practical reasons. In accordance with this, registrations in the DREAM database were divided into three 16-week intervals, covering 48 weeks total, corresponding to the time intervals in the study design (see time line in figure 1).

At the onset of the trial, registration in DREAM covered either "no registration" or a registration of "part- or full-time sick leave", with the exception of one participant registered with "early disability pension". The threshold for registration in the database with full or partial sick leave compensation is two consecutive weeks on sick leave. As the trial timeframe moves through the 48 weeks, registrations of the participants diversify into six additional categories: (i) unemployment, (ii) public education grant, (iii) flexible job (Danish labor market arrangement for people with reduced ability to work, wage is partly compensated), (iv) rehabilitation, and (iv) maternity leave.

Registrations in DREAM of part- or full-time sick leave were used in the analysis of cumulative weeks registered in DREAM within the different phases of the trial. For the analysis of return to work, a registration of part- or full-time sick leave in DREAM was used in conjunction with unemployment as negative outcomes, while no registration in DREAM, public education grant, flexible job, rehabilitation, and maternity leave were all defined as positive or neutral outcomes.

Statistical analysis

For statistical analyses, we used the STATA (Stata Corp LP, College Station, TX, USA) software package. Baseline characteristics were compared using the Chi-squared test of comparable distributions and the Student's t-test. Both self-reported and register-based

data were skewed, depicting a U-shape in a histogram, reflecting many participants with either no or the maximum amount of absenteeism from work. As a result, the Mann-Whitney U-test was used to test for differences in the cumulative number of days and weeks in the different phases of the trial. Calculation of Somer's *D* was used to estimate the percentual difference in sick leave registrations between two randomly chosen participants from the intervention and WLC groups.

Cumulative probability of being registered in the DREAM database over time was performed by drawing a Kaplan-Meier plot and testing for difference between the two groups with a Cox regression. "Leaving the DREAM database" was defined as four consecutive weeks with no registration in the database. Model validation of the proportional hazards assumption was performed by visual inspection of a log-log plot of the survival curves and the proportional hazards test.

For the self-reported data, those dropping out of the study or failing to complete their follow-up measurement for each phase of the trial, could not be included in the analyses (see figure 1 for number of participants with incomplete data). Register-based data were not affected by dropout and analyzed as intention-to-treat.

When measuring the amount of days or weeks of sick leave, one can compare the intervention and WLC groups in two different ways in this study design. One form of comparison is to look at the difference between the two groups in the first phase of the trial, where you compare the intervention to no intervention, represented by the WLC condition. With reference to figure 1, this means investigating differences between the two groups on the T1 reporting of days absent in the past three months for the self-reported data and in the interval from week 1–16 for the DREAM database data. Another mode of comparison is to look at the whole timeframe of the study and compare the two groups as a case of early or delayed intervention. One then investigates whether the amount used of the given resource accumulates over time, depending on whether the intervention comes early or is delayed. Referring again to figure 1, this can be achieved by looking at DREAM database registrations in weeks 1–16, 17–32, and 33–48, as well as in the whole timeframe (ie, weeks 1–48).

Results

Baseline characteristics

Demographic characteristics of participants at the time of inclusion to the trial are presented in table 1. No significant differences were found between the two groups.

A total of 40 participants were not registered in DREAM at inclusion in the study, while 61 participants were on part- or full-time sick leave, and 1 participant was registered with early disability pension (see table 1). At the end of the trial, in week 48, a total of 75 participants were not registered in DREAM, 16 were registered with part- or full-time sick leave, and 11 participants had other registrations [unemployment (N=2), education grant (N=2), flex job (N=4), rehabilitation (N=2), early disability pension (N=1), and maternity pay (N=1)].

A total of 14 participants in the WLC group consulted a psychologist outside of the study, with a mean number of 5.4 visits. However, surprisingly, 13 participants from the intervention group also consulted a psychologist outside of the study but while still in group, with a mean of 3.1 visits.

Hypothesis 1: cumulative duration of sickness absence

In table 2, results on self-reported absenteeism from work, represented by days full- or part-time absent from work in the preceding three months, are presented. Median and mean days absent are presented for both groups, and results of the Mann-Whitney U-test are displayed, comparing the intervention to the wait-list control condition. Using Somer's *D*, a 29% [95% confidence interval (95% CI) 5–52] reduction of reported days on sick leave was found.

For the self-reported data, a number of participants dropped out of the study and did not provide data at the follow-up measurements (see figure 1). Dropout analyses were performed and revealed no systematic differences between those dropping out of the study and those remaining in terms of gender, age, sick leave status or PSS-score at inclusion. Also, no systematic differences were found between those dropping out of the intervention and WLC groups, respectively.

Results on long-term absence from work, represented by the cumulative number of weeks registered with either part- or full-time sick leave in the DREAM database, are presented in table 3. Results are displayed for the each of the phases of the trial, the entire timeframe of the trial, and the 48 weeks prior to randomization. Results of the Mann-Whitney U-tests are presented, comparing the two groups in the first phase of the trial, in the entire timeframe of the trial, and in the 48 weeks prior to randomization. Using Somer's *D*, a 21% (95% CI 0–42) reduction in DREAM registrations of sick leave was found.

To control for possible gender differences driving the observed effects, the analyses were re-run for women only. This only slightly affected the estimates.

Supplementary analysis

We have performed supplementary analyses, looking at those working and on sick leave at inclusion to the study,

Table 1. Demographic characteristics of participants at the time of inclusion to the study. [GP=general practitioner.]

Characteristic	Intervention (N=51)				Wait-list control (N=51)			
	N	%	Mean	Range	N	%	Mean	Range
Gender								
Female	41	80.4	.	..	43	84.3	.	..
Male	10	19.6	.	..	8	15.7	.	..
Age	.	.	44	28–61	.	.	46	24–58
Referred by								
GP	24	47.1	.	..	29	56.9	.	..
Union	4	7.8	.	..	6	11.8	.	..
Phone	23	45.1	.	..	16	31.4	.	..
On sick leave								
No	21	41.2	.	..	19	37.3	.	..
Part- full-time	29	56.9	.	..	32	62.7	.	..
Other status	1	2.0	.	..	0	0.0	.	..
Contacted GP	49	96.1	.	..	50	98.0	.	..
School education								
9 years	10	19.6	.	..	11	21.6	.	..
12 years	41	80.4	.	..	39	76.5	.	..
Further education								
Short (<3 years)	18	35.3	.	..	14	27.5	.	..
Medium (3–4 years)	28	54.9	.	..	29	56.9	.	..
Long (>4 years)	5	9.8	.	..	7	13.7	.	..
Years in workforce	.	.	18	1–38	.	.	17	2–37
Occupation by field								..
Social	14	27.5	.	..	15	29.4	.	..
Health	7	13.7	.	..	9	17.7	.	..
-	9	17.7	.	..	5	9.8	.	..
Administration	10	19.6	.	..	3	5.9	.	..
Other	10	19.7	.	..	13	25.5	.	..

Table 2. Self-reported absenteeism from work, represented by days part- or full-time absent from work in the previous three months. Results are reported for the different phases of the trial, with a corresponding P-value from the Mann-Whitney U-test statistical analysis. [95% CI=95% confidence interval].

	Intervention		Wait-list control		P-value
	Days	95% CI	Days	95% CI	
Days full- or part-time absent from work–T1					
Median	11	3–25	45	19–60	0.02
Mean	27	18–37	44	33–54	.
Days full- or part-time absent from work–T2					
Median	5	1–40	12	4–58	.
Mean	28	17–38	32	20–45	.
Days full- or part-time absent from work–T3					
Median	.	..	4	2–21	.
Mean	.	..	25	13-37	.

separately. We are aware this introduces a division of the study population in addition to that provided by the randomization. However, since the distribution of those on sick leave and those working is almost equal in the two groups at the time of inclusion (see table 1), we were motivated to look at these two groups separately. This may provide insight into differences in the effects of the intervention depending on the participants' starting point.

For the self-reported data of those working at time of inclusion in the study, at the first follow-up measurement (T1 in figure 1), we found a median number of 4.5 days (range 2–14) on sick leave for the intervention group, compared to a median of 7.5 days (range 1–40) for the WLC group (P=0.33). For those on sick leave at inclusion to the study, the intervention group reported a median of 32 days (range 7–66), compared to a median of 61.5 days (range 43–90) in the WLC group (P=0.07).

From the register-based data, for participants working at time of inclusion in the study, we found in weeks 1–16 a median of 0 weeks (range 0–0) registered in DREAM for the intervention group, compared to a median 0 weeks (range 0–5) for the WLC group

Table 3. Register-based records of absenteeism from work, represented by cumulative number of weeks registered with part- or full-time sick leave in the DREAM database. Results are reported for the different phases of the trial, the complete time interval, as well as the 48 weeks prior to randomization. Reported P-values are from the Mann-Whitney U-test statistical analyses. [95% CI=95% confidence intervals].

	Intervention		Wait-list control		P-value
	Weeks	95% CI	Weeks	95% CI	
Weeks in DREAM, weeks 1–16					
Median	6	0–11	12	8–16	0.06
Mean	7	5–9	10	8–11	.
Group total	360	..	486	..	.
Weeks in DREAM, weeks 17–32					
Median	0	0–1	0	0–11	.
Mean	4	2–5	6	4–9	.
Group total	190	..	328	..	.
Weeks in DREAM, weeks 33–48					
Median	0	0–0	0	0–0	.
Mean	2	0–3	4	2–5	.
Group total	92	..	183	..	.
Weeks in DREAM, weeks 1–48					
Median	8	1–13	14	8–27	0.07
Mean	13	8–17	20	14–25	.
Group total	642	..	997	..	.
Weeks in DREAM, 48 weeks prior					
Median	8	5–13	11	6–17	0.57
Mean	12	8–15	13	10–17	.
Group total	590	..	678	..	.

(P=0.11). For those on sick leave at the time of inclusion, the intervention group has a median registration of 14.5 weeks (range 10–16) in DREAM, compared to a median of 16 weeks (range 12–16) for the WLC group (P=0.27).

Hypothesis 2a: rate of return to work

Changes in the rate of lasting return to work (or equivalent) are presented in figure 2 for the 60 participants who were on sick leave at randomization. The median period of return to work was week 16 (range 11–26) in the intervention group, compared to week 33 (range 14–43) in the WLC group. This difference translates into a hazard ratio of 1.58 (range 0.89–2.81) favoring the intervention group (P=0.12).

Hypothesis 2b: incidence of new sick leave spells

We also conducted an analysis of incidence of new periods of sick leave, for participants who were working at randomization (N=42). During the follow-up in weeks 1–16, two individuals from the intervention group (N=24) and four from the WLC group (N=18) entered a period of sick leave registered in the DREAM database. A further four individuals from the intervention group entered a period of sick leave in weeks 17–32. In total, six participants (25 %) from the intervention group, and four (22.2 %) from the WLC group entered a period of sick leave in the 48 weeks of follow-up. There were too few cases to perform a statistical test.

Discussion

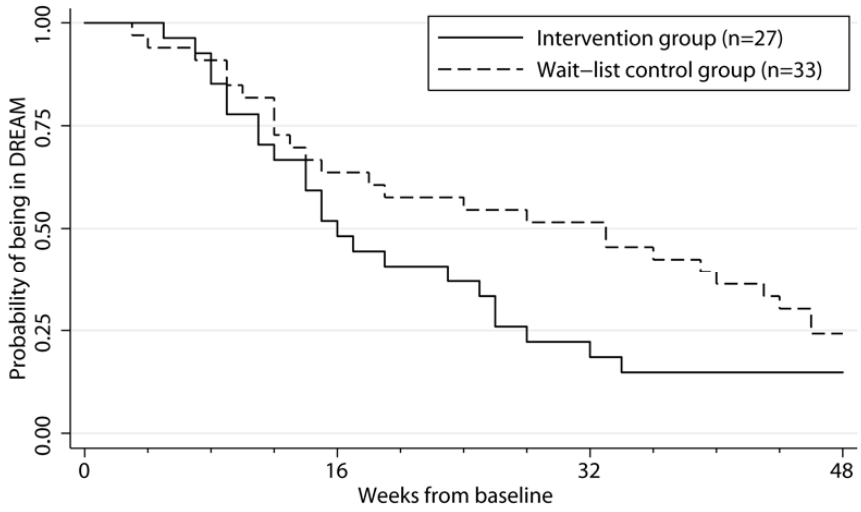
Findings in relation to hypothesis 1

From a randomized, WLC trial, we have found a reduction in self-reported absenteeism from the intervention compared to the WLC condition in the first phase of the trial. The difference between the two groups on median number of days absent from work was 34 days, corresponding to a 5–55% reduction. Regarding participants' long-term absence from work in weeks 1–16, a three weeks difference in the median number of weeks registered in the DREAM database was observed, corresponding to a 0–40% reduction, but falling short of reaching statistical significance.

On long-term absence from work across all phases of the trial, there was a tendency for the intervention group to have fewer weeks registered with sick leave. This was calculated considering the complete timeframe of the study, from 1–48 weeks, indicating a possible reduction in long-term absence from work, from an early intervention.

Findings in relation to hypothesis 2a

The rate of return to work among participants that were sick listed was faster in the intervention group, all though not statistically significant. In the first phase of the trial, both groups saw a decline in sick leave registrations, which accelerated for the intervention group compared to the WLC group in the following stages



Note: Intervention group receives the intervention between weeks 0–16.
Wait–list control group receives the intervention between weeks 16–32.

Figure 2. Kaplan-Meier plot of rate of lasting return to work (or equivalent), represented by the cumulative probability of being on part- or full-time sick leave or unemployed. Based on participants registered with sick leave in DREAM at randomization (N=60). Lasting return is defined as four consecutive weeks off on sick leave or unemployment.

of the trial. This was contrary to our expectations of a more immediate effect of the intervention within the first month after baseline and may lead to questioning whether the 16-week follow-up period was long enough to catch up on the effects. Also, we saw a decline in sick leave registrations in the WLC group before receiving the intervention. This may be due to the inclusion criterion of a planned return to work for those on sick leave at inclusion, but may also highlight that factors apart from the intervention influence return to work. Overall, for both groups three out of four, who started out on sick leave, returned to work (or equivalent) by week 48.

Findings in relation to hypothesis 2b

Regarding the incidence of new spells of sick leave, for those working at the time of inclusion, one in four participants entered a new spell of sick leave during the follow-up period. There were too few cases to analyze differences between groups and we cannot formally test hypothesis 2b with the sample size in this study.

Comparison with previous studies

In their study, de Vente et al (11) found a trend towards more days absent, comparing two stress management interventions based on cognitive behavior therapy with care-as-usual. Care-as-usual was defined as consultion of an occupational physician (mean number of visits 2.56), general practitioner (mean number of visits 1.44) or a psychologist/social worker (mean number of visits 4.64, N=11). In our study, we compare a cognitive behavioral stress management intervention with a WLC condition. Participants in the latter condition were not hindered in seeking other help while on the wait-list, and reported a mean 2.5 visits to their general practitioner while 14 participants on the wait-list reported consultations with a psychologist outside of the study (mean of 5.4 visits). There appear to be some similarities between de Vente et al's care-as-usual condition (11), and the WLC condition employed in our study. However, contrary to the findings of de Vente et al, the cognitive behavioral intervention program we investigated was found to be effective in lowering self-reported absenteeism. The diverging findings may be by explained by differences in the content of the stress management interventions, but also that they are embedded within two different labor market regulations (namely, Denmark and the Netherlands).

In the study by Blonk et al (6), a stress management intervention based on cognitive behavior therapy was not more effective than the no-intervention control group. However, a combined intervention (based on cognitive behavior therapy but with the added components of a graded activity scheme guiding the rate of return to work and workplace interventions) surpassed both the control and group format intervention. In our study, contrary to the Blonk et al study (6), we found that an intervention based on cognitive therapy is superior to a WLC group. Blonk et al's added elements of graded activity schemes and workplace interventions were not part of the intervention manual used in our study.

The study by Klink et al (12) compares a graded activity scheme intervention, based on the cognitive behavioral approach "stress inoculation training", with care-as-usual visits to a resident occupational physician

within a postal company. An effect on return to work and absenteeism was found. As in the previous study, the graded activity component is central to the intervention. This component was not explicitly part of the intervention manual in our study. Another difference between the two studies is the population sample, where the Klink et al study is situated within a specific company and reports 63% male participants. These differences reduce the comparability of the Klink et al study to our study.

Validity

There are several factors to consider when evaluating the internal and external validity of this study. In the first phase of the trial, comparing the intervention to the wait-list, observed differences may reflect an effect of the intervention. On the other hand, observed differences may also be associated with the WLC study design, which may compromise internal validity. One can speculate that a participant randomized to the waiting list may postpone work resumption as planned, until the wait-list is over. Another threat to the internal validity may also come from the WLC design; since those on the wait-list do not receive any placebo treatment. Compared to those receiving the intervention, it is not possible to discern whether the observed effects stem from the gesture of offering any form of help or if the effect is due to specific components of the intervention. From research on the efficacy of psychological treatments in general, it is known that the effects one can expect stem from both non-specific and specific factors (23).

In the study, we see a low drop-out rate in the WLC phase of the trial; the drop-out is distributed between the two groups, supporting the internal validity of the study.

Compared to the general working population, participants are weighted towards being middle-aged female workers working in the social, healthcare, education, and administration sectors. Less is known from this trial on the effects of the intervention on, for example, male or blue-collar workers, which may threaten the external validity of the study. Also, we have no measure of the extent of sickness presenteeism (ie, going to work despite not feeling fit for work), which may be more associated with some occupations than others (26).

Both the self-reported and register-based data have their strengths and limitations. The self-reported data reflect both short and long-term spells absent from work. However, the retrospective sampling method used lends itself to potential recall bias and also information bias in terms of a potential drive to "please the researchers" after receiving the intervention. Dropout is another source of bias, as cases are lost at follow-up measurements. On the other hand, data from the DREAM register reflect only long-term spells of absence (>2 weeks). DREAM is an administrative database and an objective source of information not influenced by recall bias, and unaffected by dropout.

When studying absenteeism and return to work, administrative regulations of the labor market may have powerful consequences in guiding worker behavior and actions. In Denmark, a worker can receive a maximum of 52 weeks on sick leave with full compensation. This may impose pressure on participants who are approaching the limit of 52 weeks of absence, limiting the comparability of our study with studies from other countries.

Both the self-reported and register data on absenteeism are highly skewed. The differences found between the groups may be driven by differences at the extreme ends of the distribution of the data, as proposed by Loisel et al (27). In a histogram, we see more participants with no days or weeks absent in the intervention group, and more participants with all days or weeks absent in the WLC group. In the distribution of the data between these two extremes, the differences between the groups are less pronounced.

Concluding remarks

We believe the observed reduction in absenteeism from work has potential clinical and practical implications, since costs associated with absenteeism from work is a major concern for employers and society. It is an unanswered question whether the intervention improves the health of participants, also because the concept of health has multiple definitions. The intervention aims to improve participants' motivation to face challenges experienced at work and supplies a set of tools, as well group support, to take an active stance toward handling those challenges.

In conclusion, we have found support for our first hypothesis: the intervention reduces self-reported absenteeism from work when compared to a WLC condition. Using register-based information on long-term absence from work a similar trend was found, but did not reach statistical significance. With regards to the second hypotheses, no conclusive evidence was found on the rate of lasting return to work (or equivalent) for those on long-term absence from work at the onset of the trial or on the incidence of new spells of sick leave for those working at the time of the study.

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