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One objective of the Dutch Organisation for Scientific Research (NWO) Research Programme on Fatigue at Work was to obtain more knowledge about the occurrence and course of fatigue, risk factors, causal processes, and mechanisms. A second objective was to provide actual contributions to prevention in companies and to the quality of occupational healthcare. The studies presented in this supplement show the progress in research contributing to occupational health.

Prolonged fatigue can have a number of adverse effects, as is shown by studies presented in this supplement.

The hypothesis that work related fatigue can be an essential link in the causal string of events departing from job demands, resulting in work related stress reactions, and finally leading to serious health problems was confirmed by Sluiter *et al* (p i62).[1] Fatigue increases the risk of being injured in an occupational accident (Swaen *et al*, p i88).[2] Fatigued workers had a relative risk of 1.75 for being injured. An important finding from a medical point of view was the association found between need for recovery and the subsequent risk for cardiovascular disease as reported by van Amelsvoort *et al* (p i83).[3] The relative risk was 3.16 in the highest need for recovery tertile measured at baseline. The authors suppose that the need for recovery might be an intermediate factor in a causal relationship between job stressors and cardiovascular disease. Other research, based on the Maastricht Cohort Study, indicates that fatigue increases the risk for common infections as well.[4]

A strong and consistent effect on sickness absence is the finding in a study by Janssen *et al* (p i71).[5] After adjustment for a number of factors, fatigued employees had an increased risk for being absent for over 42 days. van Amelsvoort *et al* demonstrated the predictive value of fatigue for permanent work disability.[6] It is not clear in all cases whether the reported increased risks have to be interpreted in a simple causal inference scheme with fatigue as the cause. In some studies it cannot be ruled out that fatigue is an accompanying symptom of an unknown underlying process or a part of a more complex process. Nevertheless, the occurrence of fatigue and especially its persistence should stimulate a search for causes in science and in practice and should be a reason for effective preventive measures, therapy, and rehabilitation. The first and most obvious mode for prevention is to reduce risk factors for fatigue, such as work demands, and to enhance the capacity of employees to cope with these factors. Clearly a number of risk factors have been identified in numerous studies. In this supplement increased prevalences were observed in shift workers (Jansen, p i47).[7] High psychological job demands, low decision latitude, conflicts, high emotional demands, and job insecurity have been shown to be strong risk factors for fatigue.[8] The prevalence of fatigue and its secondary effects are such that preventive measures and even regulatory actions are warranted. There are arguments, more than before, to focus studies and prevention on specific groups of workers.[9–10] However, knowledge is limited about effective methods and strategies. Therefore, much effort has to be invested in the evaluation of occupational health care[11] in order to contribute to a framework of a more evidence based occupational health.[12]

One efficient way to reduce the incidence and prevalence of fatigue could be the development of a threshold limit value. A parallel can be drawn with legal occupational exposure limits to prevent adverse health effects of occupational exposure to chemical substances, noise, and radiation. These limits have greatly contributed to a substantial reduction in exposure. As a result, the occupational environment has been transformed in many countries from a life and senses threatening environment to a more safe and comfortable one. The NIOSH lifting guidelines are another successful example of development and implementation of limit values. We propose a similar approach for psychosocial work characteristics known to have adverse health effects on workers. Psychosocial threshold limit values or benchmarks based on well designed studies will stimulate employers and employees to take preventive measures of various kinds, reducing, for example, work pace, the amount of work, work pressure, stimulating social support and decision latitude, enhancing skills of the employees, and implementing pro-active policies in companies. We might consider focusing on limit values or benchmarks embedded in health surveillance programmes with limit or action values for the prevalence of job strain or fatigue as early effects. The advantage of using early effects compared with limits for direct "exposure" (work pace, work pressure) might be a more direct relationship with adverse health effects. Thus, the legitimation of limit values is easier to defend and this will foster implementation.

In addition to primary prevention, methods for secondary prevention should be developed and evaluated, focusing on detection and reduction of early effects. A meta-analysis of 48 experimental studies of stress management techniques indicated that cognitive behavioural interventions were more effective than other types of interventions.[13] Research is needed with respect to the most appropriate target group because blue collar workers were seldom object of study.

For therapy and occupational rehabilitation we need instruments to differentiate between more common mental disorders and serious psychiatric disorders such as depression and anxiety disorders, substance misuse, and psychosis. In a study presented in this supplement the Depression Anxiety Stress Scales has been validated (Nieuwenhuijsen *et al*, p i77). [14] The scale is recommended for use in occupational healthcare to rule out anxiety disorders and depression in employees with mental health problems. The prevalence of both disorders in this population were 21% and 23%, respectively, which illustrates the need for good diagnostic instruments. The effectiveness of an activating intervention based on cognitive behavioural principles when employees are on sick leave for mental health reasons, was the subject of a randomised controlled trial.[13] A substantial reduction of sickness absence could be demonstrated, comparing the experimental intervention with care as usual. In the course of time a substantial reduction in symptoms was found in both groups, without differences between the groups. But even when effective interventions are developed, we do not know how these should be embedded in the organisation of occupational healthcare. Providing occupational rehabilitation guidance that has a continuous character was related to shorter time to work resumption, as were interventions in the direction of the company (Nieuwenhuijsen et al, p i21).[15]

Finally, groups at extra risk have to be identified. Employees with a chronic illness are clearly at an increased risk of developing fatigue. This was shown by studies within the programme (Weijman, p i93),[16] and by other studies.[17] Diabetes related symptoms, lack of social support, and the presence of high job demands without job control contribute

to fatigue (Weijman *et al*, p i93).[16] Thus, both disease consequences and work characteristics should be taken into consideration by employees with a chronic health condition themselves, supervisors, and health care providers. The current state of the art regarding insight into aetiology and course is such that design and evaluation of prevention in companies and occupational healthcare has a high priority. Experimental and field studies should be conducted to obtain insight into effective strategies to reduce fatigue in the working population.

The studies presented in this supplement clearly indicate that fatigue at work is a phenomenon with a high prevalence and with potential serious consequences for the affected population. Therefore, more priority should be given to its reduction and prevention.

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