General introduction

Associations between VO$_{2\text{max}}$ and vitality in older workers: a cross-sectional study.

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Challenges of the 21st century: facing the ageing workforce

We will have to deal with an ageing workforce, which creates a relative labour shortage in the near future [1]. The baby boom after the Second World War, longer life expectancies, and lower birth rates are leading to an ageing society. In addition to the ageing society, labour participation decreases with ageing from 75% for workers aged 25-49 years to less than 60% for workers aged 50-64 years [2]. If nothing is done, we are facing a labour market shrinkage of nearly 15% over the next five decades [2,3]. Consequently, a shrinking number of economically active people (i.e. workers) will have to pay for the national pensions of an increasing number of retired persons [4], which leads to serious financial consequences from societal perspective.

To overcome the consequences of an ageing society, older workers are needed in the near future. In order to do so, the definition of an older worker has to be clear. As chronological ageing starts at birth and ends at death, anyone in the workforce can be considered as an ageing worker [5]. However, ageing is not simply an effect of time, but refers to many changes in biological, psychosocial and social functioning over time [5]. Also, differences between individuals occur with respect to ageing. For instance, there are large individual variations in abilities and functioning, health status, and in social and self-perceptions of ageing. The definition of an older worker is based on the period at which major changes occur in functional capacities and relevant work-related outcomes [5]. Hence, an older worker is defined as a worker aged 45 years and over [5]. To explain, the functional capacity (i.e. mental and physical) of workers decreases as a consequence of an age-related decline in health that occurs, such as a decline in aerobic capacity ($\text{VO}_{2\text{max}}$), starting at the latest after the age of 30 years, changes in musculoskeletal capacity (i.e. poorer muscular strength, endurance and flexibility), after the age of 45 years, and a decline in cognitive resources (i.e. processing speed, working memory, sensory functions) [5-8]. Furthermore, older workers experience a reduced capacity for physically demanding tasks and decreased self-perceived energy levels [8].

Retaining the older worker

Although older workers are often associated with negative work aspects, there are good reasons to maintain older workers in the workforce. The older
worker is an experienced, committed, hardworking and skilled worker that is faithful to the employer and highly motivated to learn [5,9]. Although mental capacities may decrease due to a decline in cognitive resources, however, there are also some mental capacities that seems to improve with age, like wisdom and stable personality traits [10,11]. Also, older workers are known for their professional strengths, such as their ability to comprehend the whole (i.e. helicopter view) and their positive influence on team processes (e.g. decision making, feedback, mutual learning) [12].

The upcoming labour shortage together with the reasons to maintain older workers implies that older workers are needed in the near future. However, in the Netherlands, many workers have left the labour market over the past decades due to the social security system that functioned in a way to encourage people to leave work before the official retirement age [2]. This so-called early retirement pension was implemented during a period of widespread unemployment, with the intention of providing better opportunities for the younger generation to find jobs. However, it may have become clear that these early exits from work are no longer affordable from an economic perspective. Therefore, measures for discouraging early retirement have been initiated in the last few years. For example, in the Netherlands, early retirement in no longer supported fiscally, making voluntary early exit from work more expensive. Also, raising the official retirement age is one of the measures that will be implemented within the upcoming decades, starting by the year 2020 [13], but currently it is a topic of discussion again, since the proposed starting date is too late to cover the ageing consequences [14,15]. In addition to these governmental regulation, it is essential to increasing older workers’ employability. Factors that enable workers to prolong their working life are related to workers’ health status [16,17], for instance, job redesign to prevent work strain (physical and mental), optimal balance between workload and capacity, and a healthy lifestyle [16,17]. Hence, to enable workers to prolong their working life and increase their employability, it is important to maintain and promote their health status [18-21].

The older worker within the occupational health setting
In order to prolong the working life of older workers and increase employability
within the occupational health setting, the concept of work ability has been developed [22]. The bases for work ability are health and functional capacity (i.e. physical and mental capacities). However, work ability is also determined by professional knowledge and competence (i.e. skills), values, attitudes, motivation, and work itself; all factors that are closely related to the aforementioned motives for continuing working until older age [22-24]. It is important to maintain a good work ability, since it has been found to be associated with high quality of work, high productivity, less sick leave and enjoyment of staying in one’s job [25]. However, work ability changes greatly throughout working life, because ageing has an impact on the bases of work ability, namely workers’ health and functional capacities, which may lead to an imbalance between the functional capacity and the work demands.

A concept that is an early indicator of this imbalance between functional capacity and work demands, and is negatively affected by ageing [26,27], is the need for recovery after a day work (NFR). NFR is defined as the need to recuperate from work-induced fatigue, mostly experienced after a day of work [28]. If there is not enough time to recover from work-induced fatigue, the cumulated effects of this short-term fatigue will lead to long-term adverse health effects (e.g. emotional exhaustion, psychosomatic health complaints, cardiovascular diseases) [29,30]. Therefore, it is essential to maintain a low NFR, as low NFR levels are associated with less sick leave [31], which is an important predictor for early retirement [32-34].

Another factor that is important for prolonging labour participation and increasing employability is work engagement. Work engagement is a concept from positive psychology [35,36] and has been defined as a form of work-related happiness [37]. It has been shown that employees who are highly engaged to their job have lower frequency and duration of sick leave, better job performance, and higher financial return [38,39]. Work engagement, measured using the Utrecht Work Engagement Scale (UWES), is defined as a positive, fulfilling, work-related state of mind and consists of three dimensions, namely dedication, absorption and vitality [36,40]. In the scientific literature, there are several definitions of vitality. Based on these definitions, vitality can be described by a mental and a physical component. The mental component of vitality reflects mental and emotional well-being, lower levels of fatigue,
mental resilience, and perseverance [36, 41-44]. With respect to the physical component, vitality is characterised by high energy levels and feeling “strong and fit” [36]. In the field of occupational health, vitality is assessed using the UWES vitality scale [36, 40]. From a more general point of view, vitality is often measured using the vitality scale of the RAND-36 general health questionnaire (i.e. Dutch version of the SF-36 questionnaire). In this thesis, the UWES vitality scale reflects more the mental component of vitality in a workplace setting (i.e. work-related vitality), whereas the RAND-36 vitality scale reflects more the physical component of vitality in general (i.e. general vitality). Among older workers, little is currently known about their vitality. A recent study showed that higher general vitality was associated with fewer problems due to ageing, less barriers to perform work, less support needs to continue working life and more chance on a excellent to good work ability [45].

The concept of vitality is closely related to that of health, which was defined by the World Health Organisation (WHO 1948) as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". It is plausible to suggest that the health and vitality of older workers are negatively affected with time due to a decrease in functional capacities that occur with ageing. However, healthy lifestyle choices, such as sufficient levels of physical activity, healthy dietary habits, and relaxation, lead to better health. Therefore, improving workers' lifestyle can be considered as a promising way to positively affect health and vitality, and subsequently leads to increased employability. As employees spend up to 60% of their waking hours at the worksite, and thereby the majority of the adult population can be reached, worksites are convenient settings to promote and maintain workers’ health and vitality [46, 47].

**Worksite health promotion**

In addition to the potential reach of worksite health programmes (WHP) as mentioned above, the workplace has been indicated by the WHO (2010) as one of the priority settings for health promotion in the 21st century [46]. Furthermore, as a result of the aforementioned paradigm shift in occupational health, worksite health promotion has become more common in Western countries over the past years [48]. Further, organisational and social support
can easily be made available, and large enterprises often have the infrastructure available to offer such programmes at relatively low costs [49]. Also, employers have a social duty to take care of the health of their employees according to the Dutch government [50], although they are not legally obliged to engage in worksite health promotion [48]. In addition, employers may benefit from implementing WHP programmes, as investment in workers’ health is expected to favourably affect important outcomes from employers’ perspective, such as sick leave, productivity, workers’ compensation, and company image [51-54]. The beneficial effects of WHP programmes on work-related outcomes, such as sick leave and presenteeism, have indeed been reported [55-57]. Also, positive effects of WHP programmes on health [58] and lifestyle behaviours have been reported, such as physical activity [59] and dietary habits [60], and also obesity [61]. In addition, WHP programmes aiming at physical activity and/or dietary behaviour may generate financial savings in terms of sick leave and medical costs, although this was less clear for cost-effectiveness evaluations performed alongside studies with a randomised controlled trial design [62].

**Objectives of the Vital@Work study**

The primary objectives of this thesis are:

1) To investigate the association between aerobic capacity and vitality, and the relationships between aerobic capacity, work ability, and sick leave, and the role of age in this relationship;

2) To systematically develop the Vital@Work intervention and to describe the design of the intervention study, evaluating its process and (cost-)effectiveness;

3) To study the intervention process, the effectiveness and the cost-effectiveness of the Vital@Work intervention.

**Outline of this thesis**

The starting point for the Vital@Work study was the clarification of the concept vitality. To do so, a cross-sectional study was conducted to study associations between aerobic capacity and two widely used measures of vitality (i.e. UWES vitality scale and RAND-36 vitality scale). The results of this cross-sectional study are described in chapter 2. Further, we investigated our hypothesis that fit workers have higher work ability and are therefore at lower risk for sick leave and that this relationship differs between young and older workers. This
was examined using a longitudinal dataset from a large Dutch company (i.e. Siemens Netherlands). The results of this study are described in chapter 3. To improve the older workers’ health and vitality, a lifestyle intervention was systematically developed using the Intervention Mapping (IM) protocol [63], and this is described in chapter 4. The study design to evaluate the effect of the intervention has also been included in that chapter. The intervention was evaluated using a randomised controlled trial (RCT) design, the Vital@Work study, among 730 older workers (i.e. 45 years and over) employed at two major academic hospitals in the Netherlands. For understanding of the study findings, it is useful to determine the degree to which the intervention was implemented by the provider and used as planned by the intervention recipient [64,65]. This was described in a process evaluation of the Vital@Work intervention (see chapter 5). Whether the Vital@Work intervention was successful on improving lifestyle outcomes (i.e. vigorous physical activity (VPA), sports, and fruit intake), mental health, aerobic capacity and need for recovery is described in chapter 6. The effectiveness on the Vital@Work intervention on work-related outcomes (i.e. vitality, work engagement, productivity, sick leave) is described in chapter 7. Occupational health policy decisions are not primarily or only guided by the available evidence on the effectiveness of interventions, but also by considerations of their costs in relation to their effects and financial benefits [66-68]. Hence, the cost-effectiveness and return of investment of the Vital@Work intervention was evaluated and this is described in chapter 8. The thesis is concluded with a general discussion, as presented in chapter 9.
Reference List


