General discussion
With ageing populations, there is a need to keep the workforce vital and healthy to increase employability and to prolong their labour participation. The main focus of this thesis was to develop and evaluate the Vital@Work intervention, which was a worksite health promotion (WHP) programme in order to improve older workers’ lifestyle and vitality. For the evaluation of the Vital@Work intervention, a Randomised Controlled Trial (RCT) was conducted; i.e. the Vital@Work study. In the first part of this general discussion, the main findings of that trial are summarised. Next, methodological considerations are addressed, and the relevance of the findings is discussed. To conclude, recommendations for future research as well as practical implications of the findings are provided.

**Main findings**

We showed that aerobic capacity was associated with a general measure of vitality (i.e. the RAND-36 Vitality Scale), but not with work-related vitality (i.e. the UWES Vitality Scale) (see chapter 2) [1]. Also, there was a significant relationship between aerobic capacity and work ability, and between work ability and sick leave. Work ability mediated the relationship between aerobic capacity and sick leave. Age did not affect these relationships (see chapter 3) [2]. Hence, interventions aimed at improving aerobic capacity could be effective for improving workers’ general vitality (chapter 2) as well as work ability and sick leave (chapter 3). The Vital@Work intervention was developed using the Intervention Mapping (IM) protocol (see chapter 4) [3]. The 6-month Vital@Work intervention contained a Vitality Exercise Programme (VEP) combined with three visits to a Personal Vitality Coach (PVC). The VEP consisted of a weekly guided yoga session, a weekly guided workout session, and a weekly unguided aerobic exercising, as well as provision of free fruit. The PVC visits were aimed at goal setting, providing feedback, and problem solving. The intervention was evaluated using an RCT design (i.e. the Vital@Work study) among 730 older hospital workers. The implementation of the intervention was accomplished as planned, workers were positive about the intervention (yoga: 7.5; workout: 7.8; PVC: 6.9), and most workers were willing to attend the guided group sessions (i.e. reach yoga: 70.6%; reach workout: 63.8%) and PVC visits (reach: 89.6%) (see chapter 5) [4]. The most reported reason for not attending the guided yoga and workout group sessions was a lack of time.
The process evaluation also showed the important role of the proximity of the intervention locations to the workplace, and a match between workers’ regular working hours and the time schedule for the group sessions. Directly after the 6-month intervention positive effects were found on sports participation, fruit intake, and the need for recovery after a day of work (NFR), but not on vigorous intensity physical activities (VPA), aerobic capacity, and mental health (see chapter 6). Effects on sports participation and fruit intake were stronger for workers with a higher compliance to both the guided yoga and workout group sessions, whereas effect on NFR were only stronger for high workout compliers. Neither at 6-month follow-up nor at 12-month follow-up effects were found on vitality, work engagement, productivity, and sick leave, but high compliance to guided yoga sessions favourably affected vitality (see chapter 7). Based on the economic evaluation, it appeared that the Vital@Work intervention, which costs was €149 per worker, was neither cost-effective from a societal perspective, nor cost-beneficial from the employers’ perspective.

**Methodological issues to consider**

Some methodological issues should be considered regarding the strengths and limitations of the Vital@Work study.

To start with a study strength, the Vital@Work study applied an RCT design, which is the preferred study design for investigating the effectiveness of the intervention on lifestyle and vitality- and work-related outcomes. Further, the Vital@Work study meets most of the CONSORT statement [5] criteria for high quality trials. The following criteria were fulfilled: detailed trial information was described (i.e. setting and intervention locations, eligibility criteria for participants), concealed randomisation was performed, intervention details were described to allow replication, all outcomes were reported as described in the study protocol, intention-to-treat analyses were performed, and there was a similar timing of the outcome assessment in both groups. Another strength is that, to our knowledge, the Vital@Work study was the first study that evaluated a worksite intervention consisting of both yoga and aerobic exercising aimed to promote the mental and physical components of vitality. In addition, it was the first study that investigated the effectiveness on these outcomes among older workers. As structural labour shortages are expected in the near future [6], it
is essential to extend the labour participation of older workers. The results of this study are, therefore, innovative and provide valuable information.

Some limitations should also be mentioned. First, the external validity of the study may be questionable as the intervention was specifically tailored to older hospital workers. Also, in comparison with the general Dutch worker population, the Vital@Work study participants were more highly educated workers, who were generally relatively fit and active from the start of the study. Results may, therefore, not be generalisable to other worker populations. Further, the loss to follow-up rate after 12-month was about 30%, which could be indicated as reasonable for a worksite health promotion (WHP) programme. Loss to follow-up is a common problem among primary prevention studies [7], and could induce selection bias [8]. To check the presence of selection bias, we investigated potential baseline differences between the two study groups and between completers and non-completers. It appeared that only at 6-month workers with regular working hours were slightly more likely to complete participation when compared to workers with irregular working hours, which could be explained by the guided group session that were only scheduled during daytime. Altogether, the risk of selection bias seems small.

**Programme or theory failure?**

Although the Vital@Work intervention showed positive effects on sport participation, fruit intake and the need for recovery after a day of work, the intervention did not favourably affect the primary outcome vitality. When an intervention appears to be not effective, it is interesting to know what has caused this lack of effect. In occupational epidemiology, two major candidate reasons for an intervention not being effective can be distinguished, namely programme and theory failure [9]. Programme failure implies that a poorly implemented intervention did not result in improved study outcomes. Theory failure refers to an intervention that is perfectly implemented, but did not lead to improvements in study outcomes [9].

**Programme failure**

It is known that the level of implementation of an intervention significantly impacts the intervention effects to the extent that higher levels of (or better) implementation are associated with more positive outcomes [10]. In the Vital@
Work study, the level of implementation was well documented by performing a process evaluation (see chapter 5), including the reach and participation of the intervention. Another aspect that influences intervention effects is the level of contamination between intervention and control group workers, which could minimise the difference in outcomes between the two groups. Hence, the participation of the intervention and contamination between study groups could be indicated as possible programme failures.

Participation in the Vital@Work intervention
An important reason for choosing worksites as a setting for health promotion is the possibility to reach large groups [11]. However, participation levels in WHP programmes are often disappointing, namely below 50% [12]. The initial participation in the Vital@Work study was approximately 30% and the participation rates of the guided yoga and workout sessions were 51.7% and 44.8%, respectively. These rates are comparable to those found in the scientific literature regarding WHP programmes, in which reported participation rates varied from 10 to 64% [12]. As its participation level influences effectiveness of a WHP programme, strategies to increase participation are needed. Although more research is needed as to this subject, some aspects are known to positively influence participation levels of WHP programmes. In order to improve participation rates of WHP programmes, a socio-ecological approach, which suggests that interventions should be multi-leveled by implying involvement of the physical (e.g. availability of exercise facilities near the worksite), social (e.g. social support from colleagues) and organisational (e.g. management support) environment. This socio-ecological approach was previously shown to be advantageous in promoting participation levels in lifestyle interventions [13,14]. Also, our process evaluation gave indications that such an approach may be successful to maximise participation rates of future WHP programmes involving worksite exercising. To explain, the process evaluation showed the important role of the proximity of the intervention location to the workplace, indicating that making yoga and exercise facilities available near the workplace (i.e. physical environment) could favourably affect participation rates. Furthermore, the most reported reason for not attending the guided yoga and workout group sessions was a lack of time, which could be eliminated by offering employees a WHP programme during paid working time (i.e. organisational environment). As for
the social aspect, offering group-based exercise sessions, such as done in our study, could induce social support between workers. However, in the Vital@Work study, workers could choose to follow guided group sessions at moments that matched with their time schedules, which could vary between weeks, leaving little room for social support due to changing group composition. In addition to this multi-level intervention approach (i.e. physical, social and organisational), participation in WHP programmes is higher in interventions aimed at multiple lifestyle behaviours (e.g. physical activity and/or dietary behaviour) [12]. Moreover, offering workers the possibility of individual choice as to which lifestyle behaviour they want to work on, and not forcing them into one prescribed programme, has been suggested to be effective [15]. Also, moral considerations of workers, concerning employer interference in their personal life, can influence the decision to participate in a WHP programme [16]. Although ethical aspects from the worker’s perspective remain unexplored, it is known that workers generally lack voice when it concerns WHP programmes [17]. Focus group interviews, for example held for the development of the intervention using the intervention mapping protocol (IM), can be a useful tool to consult the intended participants, and verify their perspectives on ethical issues. Altogether, important elements related to for high participation were lacking in the Vital@Work study, such as active management support for participation, social support of colleagues and the moral considerations of involved workers, indicating a programme failure. This may have dimmed the effectiveness of the intervention.

Contamination
In intervention trials, contamination between the intervention and control group should be avoided as it causes difficulties in detecting significant differences between groups. Contamination occurs when control group workers inadvertently receive the intervention or are exposed to the intervention. To avoid contamination between workers allocated to the intervention or control group employed at the same department, cluster randomisation is often used in RCTs in the occupational setting. Nevertheless, cluster randomisation leads to reduce power [18] and because participants are often recruited after the department clusters have been randomised, participants with different characteristics may be selectively included. Participants may, therefore, be
different at baseline, which may lead to biased results. Hewitt et al. (2008) stated that when contamination is less than 30%, individual randomisation is justified above cluster randomisation [19]. In the Vital@Work study, workers in the control group did neither have access to neither the guided group sessions nor the PVC visits [4]. Thus, the risk for contamination in our study was limited and could, therefore, not play an important role in the lack of effectiveness of the Vital@Work intervention. Hence, contamination between the two study groups could not be indicated as programme failure. In future WHP programmes, when cluster randomisation is not preferred due to practical reasons or power issues, individual randomisation should be considered when it is expected that severe contamination can be controlled as in our study.

Theory failure
A perfectly implemented intervention can still be ineffective if the theoretical idea and hypotheses behind the intervention were wrong. In the Vital@Work study, there are some indications regarding theory failure, including the chosen prevention approach and the concept of vitality.

Prevention approach
In the Vital@Work study a primary prevention approach was used. This approach is aimed at avoiding occurrence of diseases among the total population (i.e. a population approach) and the intervention is thereby targeting the origin of the problem. Originally, primary prevention is aimed at preventing the problem of mass diseases (e.g. cardiovascular diseases or overweight) [20]. This approach is useful when health problems at a population level are expected. For instance, an imbalance between energy intake and energy expenditure leads to overweight and subsequently, on the long run, to higher cardiovascular and cancer risks. An example of primary prevention in this case would be intervening among a normal weight population to obtain sufficient physical activity levels and health food choices. When putting this into the perspective of the Vital@Work study, primary prevention was expected to be right as problems regarding older workers’ vitality were expected. However, it appeared that the Vital@Work study population had, when compared to normative values, high subjective vitality and were highly productive and engaged to their job. This phenomenon refers to a healthy worker effect [21,22], which is often studied in occupational cohorts.
A healthy worker effect is characterised by the fact that workers usually exhibit better health conditions than the general population, because severely ill and chronically disabled are normally excluded from employment. This may be especially true for our population of ageing hospital workers, as the majority of this population has to deal with higher physical workloads than an average worker in the Netherlands. Furthermore, our population consisted of highly educated ageing hospital workers, who are characterised as workers who are highly engaged to their job and have higher subjective vitality when compared to their younger counterparts [24,25]. A recent study showed that the subscales of the UWES; i.e. vitality, dedication and absorption, remained more or less stable over time [26], indicating that if a worker is once engaged to their job, then they are likely to stay that way over time [25]. Hence, intervening among workers who were already vital and highly engaged to their job at baseline leaves small room for improvements (i.e. ceiling effect). Therefore, the chosen prevention approach (i.e. primary prevention) in our study may indicate a theory failure and could have undermined the effectiveness of the Vital@Work intervention.

The concept of vitality

In the occupational health setting, vitality is, together with dedication and absorption, one of the three dimensions of work engagement. As work engagement refers to psychological well-being at work, and beneficial effects of yoga on mental health have been reported; i.e. on anxiety, depression, stress, fatigue, and well-being [27-31], effects of yoga on work-related vitality and work engagement were expected. Nevertheless, effects were lacking probably due to the fact that we did not target relevant determinants of the concept work engagement, and thus also not work-related vitality. Several determinants of work engagement can be distinguished, namely job resources (e.g. autonomy, social support, supervisory coaching, opportunities for professional development), and personal resources (e.g. self-efficacy, organizational-based self-esteem, and optimism) [32-34]. Personal resources are individual worker aspects linked to resiliency and the ability to control and impact upon one’s own environment successfully [34]. Some of these personal resources are closely related to subjective well-being, for example optimism and resilience, but also to emotional stability [32,35]. Our intervention did not show effects of yoga on the broad concept of work engagement and work-related vitality, but yoga could have
impacted on aforementioned personal resources or subjective well-being, which were not measured in our study.

Besides the lack of effect on work-related vitality, which reflects more the mental component of vitality in a workplace setting, there were also no effects found on general vitality. As general vitality reflects more the physical component of vitality, and favourable effects of vigorous intensity physical activities on physical outcomes (i.e. aerobic capacity) are well known [36], effects of the guided workout sessions on general vitality were expected. The latter was especially true as the results of chapter 2 showed that there was an association between aerobic capacity and general vitality. Hence, the theory behind this hypothesis seems valid and this could, therefore, not been indicated as a theory failure. Although the possible programme failures of the intervention are already discussed, the lack of effect on general vitality can be explained by such a failure. To explain, for enhancement of aerobic capacity, quite intensive physical activities (at least three times a week, 20 minutes at 65 to 85% of the maximum heart rate) [37] are required, which are often not reached in worksite physical activity programmes [38]. In the Vital@Work study, we failed to ensure an increase in high intensity exercise among the guided workout sessions, as we did not monitor it. To overcome this failure in future research, it is recommended to objectively monitor exercise and/or physical activity in terms of intensity, using heart rate monitors or accelerometers.

**Relevance of found effects**

As stated in the introduction of this thesis, to enable workers to prolong their working life and to increase their employability, it is important to maintain and promote their health status [39-42], and lifestyle factors are an important determinant of health. In addition, an age-related decline in health occurs due to higher prevalence of chronic diseases (e.g. cardiovascular diseases (CVD), diabetes mellitus (DM), cancer). This prevalence will even further rise in the near future as a result of the growing obesity epidemic, which is also affecting the older workers. Another factor, besides chronic diseases, that can negatively affect workers’ health status is stress [43], which is specifically true for older workers. To explain, the nature of work has changed during the recent years due to globalization and information technologies (the ‘new economy’), which are being experienced as stressful by specifically older workers [44]
As chronic diseases are an important determinant of decreased employability, it is important to find means for decreasing the prevalence of aforementioned chronic diseases at the population level. A promising way to do so is by positively affecting workers’ lifestyle. The importance of sufficient PA levels in the prevention of aforementioned chronic diseases is well-known. Also fruits are protective against aforementioned chronic diseases, because they are relatively rich in vitamins, flavonoids, minerals, and low in energy [45-48]. Also, fruits can be consumed as a between meals snack, and thereby affecting satiety due its high water and dietary fibre content resulting in decreased energy intake and may, therefore, contribute to an alteration in snacking habits [49]. Consequently, a possible inverse association between fruit intake and overweight is suggested [49]. The Vital@Work intervention was successful in increasing sports participation with 40.4 minutes per week after the 6-month intervention, which corresponds with a relative improvement of 29.7% when comparing this average change between the intervention and control group with their baseline measures, this could be indicated as a relevant difference. This effect was partly sustained after 12-month follow-up (β: 28.6 minutes per week, 95% CI: 2.6-54.5, data not shown). Furthermore, the intervention favourably affected fruit intake with on average 2.7 pieces a week after the 6-month intervention, which reflects a relative improvement of 12.1%. Also, the Vital@Work intervention was successful in reaching those workers who were not performing sports activities or meeting the daily fruit recommendations at baseline, but did at 6-month follow-up. These findings are important, especially since the prevalence of unhealthy lifestyle behaviours are high, most notably low physical activity and poor nutrition (e.g. low fruit intake). In the Netherlands, 61% of the population engages in sufficient physical activity (i.e. at least 30 minutes of moderate or vigorous physical activity on at least five days per week) [50]. Although there are no figures available for middle-aged adults, it is known that less than 10% of young Dutch adults meet the daily recommendation for fruit intake [51]. As through workplaces the majority of the adult population can be reached, worksites are convenient settings to promote sufficient physical activity levels and fruit intake at a population level [45,52], and thereby for the prevention of aforementioned chronic diseases.

As mentioned, stress is another factor, besides chronic diseases, that can negatively affect workers’ health status [43]. In case of stress, a stressor
(i.e. physical or psychological arousal) activates the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS) [53]. Hence, stress hormones, such as cortisol and catecholamines (i.e. adrenaline and noradrenaline), are released into the bloodstream, in order to cope successfully with a stressful situation. Dysregulation of these physiological responses (i.e. sustained activation) are related to several chronic health disorders, for instance depression, anxiety- and stress-disorders, and cardiovascular diseases, but also with obesity [53-55]. All these health conditions are related to decreased employability [56]. Consequently, dysregulation of the HPA axis and SNS among older workers should be tackled or, more preferable, be prevented. In order to do so, worksite yoga programmes may be promising. In the Vital@Work study, additional analyses showed that there was a relationship between yoga and vitality only among high compliers. Several studies have shown that yoga techniques may improve indirectly mental and physical components of health through decreased levels of stress hormones; i.e. cortisol, adrenaline and noradrenaline [57-59], resulting in improved coping with numerous stressors [56]. A recent study among a small university staff population (n=48) showed promising results of the effects of a 6-week yoga on resilience to stress as well as well-being [60]. However, there are no other studies yet that have investigated the effectiveness of yoga on work-related outcomes. If compliance can be maximised, WHP programmes with a yoga component, such as the Vital@Work intervention, may be a promising strategy for successfully coping with stress and thereby preventing workers from stress-induced decline in health.

Healthy workplaces for older workers
Taking the above into account, the Vital@Work model as presented in chapter 4 of this thesis needs to be reconsidered. Therefore, in this section of the general discussion an adapted version of the model is presented (figure 1). The starting point of the Vital@Work study was the current and near future ageing of the working population, and the accompanying expected structural labour shortage [6,61]. Hence, it is essential to maximize the older workers’ contribution to the labour force. Similar to the original Vital@Work model, the adapted model aims to increase employability and prolong labour participation of older workers. However, other relevant factors are supplemented regarding
the relevance of worksite health promotion, stakeholders’ involved, important work factors related to the individual worker, and promising interventions.

**Stakeholders**
During the recent years, the more dynamic labour market has resulted in frequently changing jobs over a working lifetime, which requires more flexibility and increases the need to adapt job-related skills over time (i.e. work-based lifelong learning) of older workers [62]. As flexibility and the ability to learn new skills decline with age, these changes in daily working life can affect work performance and the ability to meet job competence requirements, making older workers more vulnerable in the labour process [62-65]. Therefore, governments and employers should invest in prolonged employability of workers and should work together with Human Resource Management (HRM), and Occupational Health Services (OHSs). The government as well as employers should facilitate WHP by creating structural financial opportunities. Investing in sustained employability through WHP is needed as the age-related decline in health may induce early retirement and affect relevant work outcomes, such as sick leave and productivity, and thereby negatively affect financial budgets. In addition, employers also consider WHP as good employment practice and part of their corporate social responsibility [66]. However, before investing, employers would like to know whether these investments generate a positive financial return [67,68]. As a logical consequence of the lack of effect found on the main study outcome (i.e. vitality), the Vita@Work intervention was not cost-beneficial from employers perspective. As there is a lack of cost-benefit evaluations (CBAs) based on randomised controlled trial evaluating WHP programmes, more CBAs should be performed to allow employers to draw balanced conclusions regarding the overall profitability of WHP programmes [69].

The ageing workforce also implies a change in OHS strategies. Traditionally, OHSs were mainly focused on the negative aspects of health, namely the adverse effects of work and interventions aiming at return to work after sick leave [70], but this negative focus has recently somewhat shifted towards preventive actions, such as WHP. Hence, the interest in the promotion of prolonged employability related outcomes, such as lifestyle, health, vitality and work engagement, is growing [70]. Since the primary prevention approach
used in the Vital@Work study could have dimmed the effectiveness of the Vital@Work intervention, other prevention approaches should be taken into account in future WHP programmes targeting vitality and related outcomes, for instance, a high-risk approach. This approach is aimed at those with an elevated risk of disease (i.e. secondary prevention). Interventions among high-risk populations are more tailored to certain lifestyle and health problems, and are thereby probably more beneficial than when individuals are targeted using a population approach as done in our study [20]. By doing so, OHSs could play a crucial role in screening workers for risk factors that threaten their employability (e.g. vitality, work engagement, work ability, NFR) during the voluntary periodic health check (i.e. PMO).

Other relevant factors for employability
As stated in the introduction of this thesis, the concept of work ability was developed in order to prolong the working life of older workers and increase employability within the occupational health setting [71]. Furthermore, work ability is a relevant work factor when it concerns the employability of older workers, as it is associated with high quality of work, high productivity, and enjoyment of staying in one’s job [72]. Also, work ability is a concept which is suitable for high-risk approaches. That is, the work ability index (i.e. the questionnaire that measures work ability) detects whether restrictions on workers work ability are expected in the future. By doing so, a need for action (e.g. WHP) can be identified in order to promote workers’ health [71,73]. In chapter 3 of this thesis we showed that there was a positive relationship between aerobic capacity and work ability and between work ability and the risk for sick leave. Hence, a WHP programme aimed at improving aerobic capacity, such as the guided workout sessions of the Vital@Work intervention, could positively affect work ability if an increase in high intensity exercise is ensured. However, the work ability was not evaluated in our study and it was neither incorporated in the original Vital@Work model. A factor that was evaluated in the Vital@Work study, but was also not incorporated in the original model, is the need for recovery after a day of work (NFR). NFR is a relevant factor to consider for older workers when it concerns their employability, because it predicts sickness absence duration [74], which is an important predictor for early retirement [75,76]. In addition, NFR, as well as subjective energy levels,
worsen during ageing [77,78]. The Vital@Work intervention favourably affected NFR at 6-month follow-up, although this was just not statistically significant at 12-month follow-up probably due to loss of power and the failing to ensure an increase in high intensity exercise. The latter is plausible as effects were stronger for high guided workout compliers. Considering their relevance for the employability of older workers, both work ability and NFR are included in the adapted version of the Vital@Work model.

*Interventions*

Aforementioned relationships between aerobic capacity and work ability and NFR indicate that a future WHP programme involving aerobic exercising, ain which an increase in high intensity exercise is ensured, may be effective in order to improve, on the long run, employability. Studies investigating the effectiveness of WHP programmes targeting employability and prolonged labour participation, older workers and/or work engagement and/or vitality are still lacking. As work engagement can be seen as subjective well-being at work [32], interventions focussing on promoting workers’ well-being and happiness at work could be promising for positively affecting work engagement and thereby the mental component of vitality in the work setting as part of work engagement [25,32]. An overview of happiness interventions known from positive psychology, which are suitable for the workplace, showed that the bases for these interventions is creating positive cognitive states of mind by, for instance, enjoying the here and now, counting blessings, and raising awareness of positive thoughts to stimulate optimism [32]. Examples of such interventions are meditation and mindfulness. The effectiveness of a worksite mindfulness intervention to promote work engagement is currently subject of investigation, of which results are expected soon [79]. As for meditation, this was a main component of the guided yoga sessions of the Vital@Work intervention. If compliance of future worksite yoga intervention can be maximised, this could be a promising strategy for promoting workers’ vitality. Also, guided yoga sessions can easily be supplemented with aforementioned cognitive components from promising happiness interventions. As for older workers, especially the amount of scientific literature regarding determinants of early retirement and the health of older workers [44,80-84], is rapidly growing. However, a recently published study showed positive effects of a 6-month intervention consisting of a web-based
risk assessment combined with personal coaching support on lifestyle behaviours, namely fruit intake and vegetable consumption [85].

Interestingly, most worksite lifestyle interventions are aimed at the individual worker. Although our intervention had one environmental component, namely the availability of free fruit, this was also true for the Vital@Work intervention. A meta-analysis of the effects on worksite physical activity and/or dietary interventions has shown greater effects for interventions that combine individual and environmental changes, compared to interventions based on one component (i.e. either individual or environmental changes) [86]. Examples of environmental change as part of a worksite lifestyle intervention are providing healthy canteen food or adapting parts of the workplaces into relax areas. Thus, ideally, combinations of individual and environmental changes should be included. Another factor that is relevant in terms of effectiveness an intervention is its participation rates. As stated before, a socio-ecological approach could beneficially affect participation rates. In doing so, aforementioned stakeholders could play a role. That is, employers could give their approval for participation during paid working hours, encourage workers to participate by giving management support, and make exercise facilities available near the worksite. Furthermore, HRM and supervisors could promote participation during the yearly evaluation (i.e. “jaargesprek”) and by occupational physicians (OPs) during the voluntary periodic health check. Taken above all together, personal resources, environmental components and participation are included in the adapted version of the Vital@Work model.

Vital@Work 2.0

The key findings of our study are that a worksite intervention consisting of yoga and aerobic exercising, the provision of free fruit, and individual coaching sessions was successful in improving sport activities and fruit intake, but did not result in overall improvements in work-related outcomes. Also, the intervention was not cost-effective. Therefore, it cannot be recommended to implement the current Vital@Work intervention as a tool to improve older workers' vitality. Therefore, we propose a Vital@Work 2.0 version for future WHP programmes based on our lessons learned. Considering the socio-ecological approach, the Vital@Work version 2.0 should be a multi-component
programme consisting of several components aimed at improving employability, including adaptations to the work environment, happiness interventions aiming at the personal resources of work engagement (i.e. mindfulness, meditation), worksite guided yoga and workout sessions to improve vitality, work ability and NFR. Due to individual differences (e.g. genetics, personality, lifestyle) between workers, and to increase participation, workers should be offered the possibility of individual choice between aforementioned components. For example, an à la carte programme can be used, which is nowadays also used in several companies to provide secondary conditions of employment. Another aspect to consider is the primary prevention approach used in the Vital@Work study, which could have undermined the effectiveness of the intervention. Hence, high-risk approaches should be taken into account in future WHP programmes targeting vitality and related outcomes. For instance, among those experiencing high stress, lack of energy or a decreased work ability. However, both high-risk and population approaches can be effective. High-risk strategies may be more effective in the short-term, whereas population approaches have the potential to be effective and perhaps cost-effective in the long-term [20,87]. When it concerns Vital@Work 2.0, it would be interesting to investigate the effects of guided yoga and workout sessions among aforementioned, but also among workers of all ages. After all, if workers are once engaged to their job, they are likely to stay that way over time [25]. Hence, both prevention approaches should be considered and investigated in more detail.

To my personal opinion, taken above altogether, employers should not only be interested in investing in programmes that generate return of investments in the short-term (e.g. one year), but should also consider investing in sustained good health of their workers in the long-term as part of good employment practice and their corporate social responsibility [66]. To retain healthy workers, who are able and willing to prolong their labour force participation, employers should work together with HRM and OHS by creating a company-wide integral health policy, in which WHP programmes are incorporated. One way to do so is by creating structural facilitating regulations. An example of such a facilitating regulation is the personal budgets (i.e. PGB: “persoonsgebonden budget”), which were implemented in the University Medical Centers (UMCs) in the Netherlands by the year 2008 as part of the collective labour agreement [88].
These budgets are aimed at improving future work functioning by, for instance, financing personal developmental activities, such as personal coaching, education, training, or specialist literature. Although investing in personal development is important to retain workers until older age, it is also important to invest in worksite health promotion. From this point of view, the costs of the Vital@Work intervention, which were €149 per worker (see chapter 8), are reasonable when taking into account that an average worker receives a PGB of approximately €325 per year of employment (i.e. 1% of gross year income, average income Dutch worker (CBS 2011) is €32,500). For other branches, a comparable budget (e.g. a personal vitality budget) could be implemented as part of collective labour agreements or as a secondary condition of employment (i.e. good employment practice).

Implications for research

- As only high yoga and workout participation showed positive effects, it is important to find effective means to stimulate compliance (i.e. participation). Therefore, facilitating and impeding factors for participation should be investigated into more detail.

- As high yoga compliance showed effects on both work-related and general vitality, this deserves to be explored further in future research. For instance, it would be interesting to investigate other possible positive effects of worksite yoga interventions on work-related outcomes related to employability, such as work performance or job satisfaction.

- To ensure exercising with certain intensity it is recommended in future research to objectively monitor exercise intensity compliance, using heart rate monitors or accelerometers, as process measure for intervention compliance.

- Although the Vital@Work intervention did not show overall effectiveness of the yoga guided group sessions, yoga is known as a form of exercise that can reduce stress by down-regulation of stress induced neuroendocrine systems. It would be interesting to investigate whether workplace yoga programmes can relieve tension and job stress among workers of all age ranges.
• High-risk strategies may be more effective in the short-term, whereas population approaches have the potential to be more effective and perhaps cost-effective in the long-term. Due to the possible influence of healthy worker and ceiling effects, it would be interesting to investigate the effectiveness of yoga and aerobic exercising among a more heterogeneous population with respect to age, vitality and work engagement (i.e. population approach), but also among workers with higher risks in terms of sick leave and disability pension or unhealthy lifestyles (i.e. high-risk approach).

• Future research should not only focus on the individual worker when it comes to worksite health promotion, but should also focus on combining individual and environmental perspectives.

Implications for practice

• As a substantial amount of the adult population spends the majority of their waking hours at work, and the positive effects shown in this study, we recommend the provision of (free) fruit at workplaces.

• A promising solution to overcome the workers’ time constraints is to make yoga and workout exercise facilities available near or around the worksite to offer employees a WHP programme during paid working time.

• Implementation of worksite yoga and workout facilities could be a useful strategy to promote vitality-related work outcomes (i.e. work-related vitality, general vitality and NFR), but only if high participation can be achieved. Employers and supervisors can play an important role by actively supporting their workers.

• Employers should work together with HRM and OHS by creating a company-wide integral health policy, in which WHP programmes are incorporated.
Figure 1. Vital@Work model 2.0

Personal characteristics: worker-related, health-related

Vital@Work 2.0
- Guided workout sessions
- Guided yoga sessions
- Minimal fruit interventions
- Happiness interventions
- Work environmental interventions

Lifestyle:
- Fruit intake
- Sport
- Vigorous PA
- Relaxation

Personal resources:
- Self-efficacy
- Optimism
- Self-esteem

Vitality-related:
Mental factors:
- Well-being
- Mental health
- Feelings of fatigue
Physical factors:
- Aerobic capacity
- Feelings of energy (vigor)
- Need for recovery (NFR)

Work-related:
- Work engagement
- Work ability
- Productivity
- Sick leave

Stakeholders

Participation

Health

Prolonged employability

Age
References


5. The Consolidated Standards of Reporting Trials (CONSORT) group. The CONSORT statement for reporting of a randomized controlled trial (RCT). Box 6 - Intention-to-treat analysis. 2011. Ref Type: Internet Communication


34. Xanthopoulou D, Bakker AB, Demerouti E, Schaufeli WB: The role of personal resources in the job demands-resources model. International journal of stress management 2007, 14: 121-141.


69. van Dongen JM, Proper KI, van Wier MF, van der Beek AJ, Bongers PM, van Mechelen W et al.: Systematic review on the financial return of worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity. Obes Rev 2011.


79. van Berkel J, Proper KI, Boot CR, Bongers PM, van der Beek AJ: Mindful “Vitality in Practice”: an intervention to improve the work engagement and energy balance among workers; the development and design of the randomised controlled trial. BMC Public Health 2011, 11: 736.


