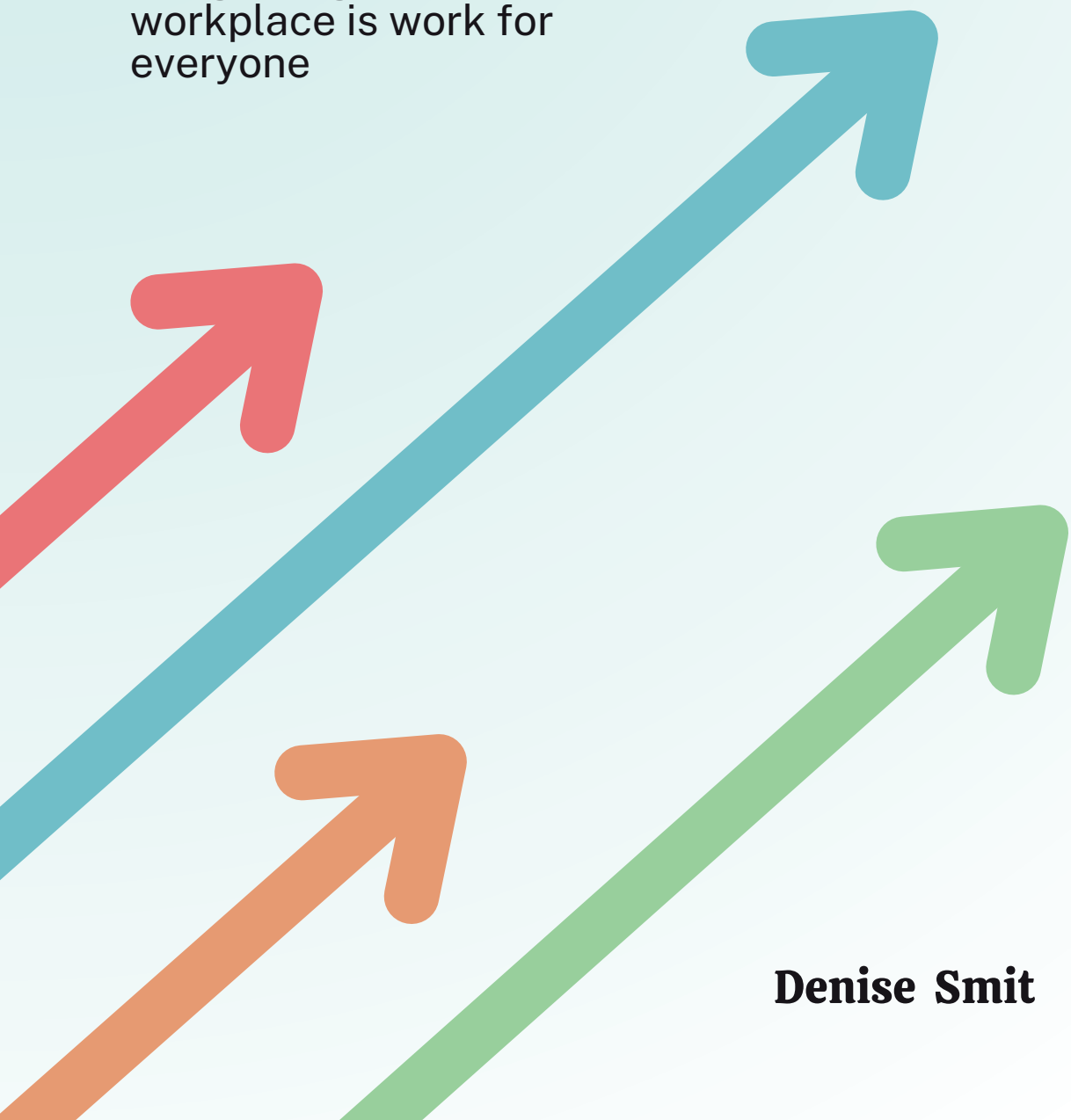
Work Towards Vitality

Integrating vitality in the workplace is work for everyone



Denise Smit

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Integrating vitality in the workplace is work for everyone

Denise J.M. Smit

Colofon

The study described in this thesis was conducted at the Center for Prevention, Lifestyle and Health of the Dutch National Institute for Public Health and the Environment (RIVM), and at the Department of Public and Occupational Health of the Amsterdam UMC, Vrije Universiteit Amsterdam, Amsterdam Public Health research institute.

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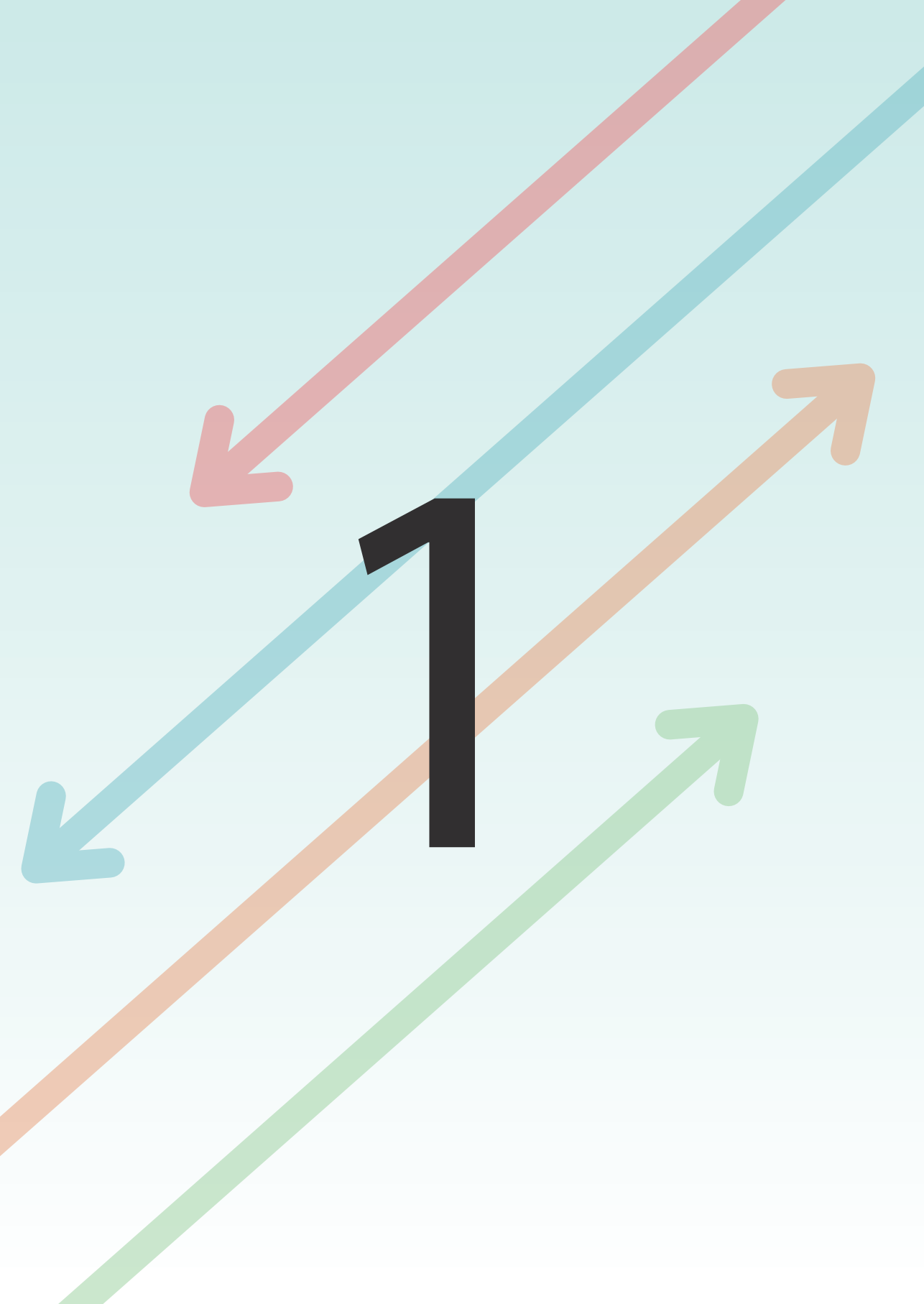

Chapter 1

General Introduction

Lifestyle and health

A healthy lifestyle behavior, including a healthy diet, sufficient physical activity and no smoking, is related to general health (1-3). On the other hand, unhealthy lifestyle behaviors are defined as preventable risk factors by the WHO Global Health Observatory for non-communicable diseases (NCDs) such as diabetes and cardiovascular diseases (4). Nonetheless, a substantial part of the adult population worldwide does not maintain a healthy lifestyle. For instance, in 2022 less than 50% of the adult population in the Netherlands met the physical activity guidelines and less than 40% met the guidelines of a healthy diet (5). In the European population, 33% met the physical activity guidelines and 21% of the adults were considered to have a healthy diet (6). Moreover, in 2021 more than a quarter of the Dutch population of 15 years and older spent more dan 8.5 hours per day sedentary (7, 8). When specifically looking at the working population, Dutch employees spent 8.9 hours in sedentary behavior on average on a working day in 2022, of which 4.5 hours took place during working hours (8). Next to the impact of an unhealthy lifestyle and related NCDs on the burden of disease, and associated strain on healthcare systems and increased healthcare costs, an unhealthy lifestyle attributes to work related disability and associated costs, such as absenteeism and presenteeism (2, 9-12). To explain, based on data from 2017 and 2018 the costs related to absenteeism of employees were more than 13 billion euros in the Netherlands, with the expected presenteeism-related costs being even higher (13-16). Promoting a healthy lifestyle among working adults to improve their health is thus of importance (17).

Vitality comprises mental and physical health

The associations between healthy lifestyle behaviors and physical health have been studied widely (18-23). For instance, increased physical activity, as well as improved dietary patterns have shown to be associated with favorable cardiometabolic health (18, 23). Additionally, these health behaviors are known to be intertwined, for instance the interplay between physical activity and diet affects body weight and changing one health behavior might lead to changes in another health behavior (24, 25). For example, sufficient physical activity can improve sleep and the other way around, poor sleep quality can negatively affect physical activity and diet quality (24). As mental health problems become more prevalent and absenteeism rates rise due to mental health issues, the importance of mental health becomes increasingly evident (26-28). To illustrate, in 2019 mental health problems were the most common disease-specific cause of absenteeism in the Netherlands (27). Hence, research towards the association between various health behaviors and

mental health is increasing (29, 30). For instance, besides the positive effects of physical activity on physical health, it also leads to a lower risk of developing depression and other mental health issues (30). Moreover, improvements of sleep quality are associated with improvements in mental health (31). These findings imply that healthy lifestyle choices can affect both the physical and mental health of adults (30). The components of mental and physical health converge in the concept of vitality, which can be described as 'the positive feeling of having energy available to the self' (32-37). The mental component of vitality reflects mental health, well-being and mental resilience, while the physical component encompasses health-related fitness, physical health and experience of energy or vigor (32). Both mental and physical health, and thus vitality, are relevant to employee functioning at work (33).

Health promotion at the workplace

To promote a healthy lifestyle and subsequently improve health and vitality of employees, employers can implement so-called workplace health promotion programs (WHPPs). Workplace health promotion (WHP) is defined as the "combined efforts of employers, employees and society to improve the health and well-being of people at work" (9). As health and vitality comprise both physical and mental components, it is essential that both are integrated in these WHPPs. There is a wide array of options within WHPPs regarding the targeted health behaviors. For example, numerous preceding WHPPs aimed to improve a (combination of) health behavior(s), such as physical activity, nutrition or mental balance (38-42). WHPPs can be implemented on the individual level e.g. providing knowledge and teaching skills and/or organizational level e.g. adjustments to the social or physical working environment with a focus on employees and/or supervisors in various occupational settings (38, 43-46). WHPPs have shown beneficial effects on the level of the employee, employer and society. For instance, as a result of WHPPs the health, wellbeing and work performance of employees improved (47-50). Hendriksen et al. (2016) reported a significant increase in work performance as a result of an intervention targeting (self-) awareness and knowledge regarding vitality and lifestyle (47). On the level of the employer, offering WHPPs can attract and retain employees and WHPPs have shown to contribute to increased productivity and decreased presenteeism and absenteeism (9-11, 51, 52). With regard to the society, WHPPs may contribute to a decrease in healthcare costs (53, 54). As the urgency to implement WHPPs is clear, many WHPPs have been studied and implemented in practice in the last years (40-42, 55, 56). Despite the alleged advantages of WHP, evidence regarding the effectiveness on health behavior and health related outcome measures, reported by various reviews is small to moderate (40, 41, 55, 57).

Two potential explanations of this lack of effect will be discussed in more detail in the following sections.

The first potential explanation for the lack of effectiveness of WHPPs is poor implementation of WHPPs into practice (58-60). Implementation of WHPPs in organizations is known to be a complex process as diverse factors at different actor levels play a role in this (59, 61-63). For instance, the main program elements should be delivered correctly, implemented WHPPs should be maintained over time and reach the participants. Moreover, the contextual factors which differ per organization, should be considered (59, 60). As the participation of employees in WHPPs has shown to be generally low, increasing the participation levels in WHPPs to subsequently increase effectiveness is necessary (58, 64). Reaching employees and getting them to participate in WHPPs is twofold. Firstly, employees should be aware of the implemented WHPP, for which clear communication is pivotal (65). Secondly, to ensure the fit between a WHPP, the organizational context and individuals within that context i.e. employees, the needs and resources should be carefully analyzed and addressed (66-68). With regard to the employees, WHPPs should meet their needs and preferences and consider their personal and work-related resources, e.g. available time during and outside of working hours and possibility to work flexible (66). Involving employees in the development and implementation of a WHPP is important to better tailor WHPPs (66, 69). Citizen science methods allow to involve the target group in a research setting, enabling WHPPs to be developed and studied in collaboration with the target group rather than solely by researchers who may have less insight into the specific organizational context (70, 71). Alignment of WHPP content with practical and contextual needs and resources of employees and the organization along with adequate implementation of WHPPs in practice are thus of great importance to increase effectiveness (58-60, 66, 72). Process evaluations can provide insight in factors related to implementation of WHPPs, but despite growing attention for their value, process evaluations are conducted to a limited extent (58, 60, 73).

Secondly, many of the studied WHPPs target the individual level only, for instance by providing information, and teaching healthy behavioral skills (74, 75). These might affect the conscious choices made with regard to healthy behavior, as they aim to provide the employee with the knowledge and skills necessary for the healthy behavior (76). However, healthy behavior encompasses not solely conscious, but also nonconscious choices, e.g. habits. Nonconscious choices or habits largely determine behavior and are expected to be more resilient to changes in motivation and might maintain after an intervention period (76-78). Thus,

interventions that target these nonconscious choices or habits may therefore be successful in changing health behaviors (76). Nonconscious decision-making can be shaped through the environment, from both a social and physical perspective, by enhancing opportunities and reducing barriers for healthy behavior (43). At the workplace, examples of such interventions are replacing traditional sit-desks with sit-stand desks or increasing the offer and visibility of healthy food in the company restaurant (39, 79). The fact that the (physical) environment influences nonconscious decision-making, underlines the importance of targeting, besides individual interventions, the work environment and organizational policies within WHPPs. The added value of including activities on the organizational level in addition to activities on the individual level was also described in a systematic review of reviews by Proper et al. (2019) (40). Next to WHPPs that target the individual level only, there are also WHPPs solely targeting the organizational level by adjusting the working environment or organizational policies (39, 80, 81). However, interventions that target both the individual and organizational level are recommended. Moreover, most WHPPs focus on one health behavior only, for instance physical activity or a smoking cessation intervention (42, 55, 82). Whilst a combination of multiple health behaviors is shown to be more effective in improving the health behaviors targeted, as these health behaviors are often intertwined (24, 25, 40). Especially in the context of vitality, in which both physical and mental components are of importance. Thus, to fully exploit the potential of WHPPs it is essential to implement activities at both the individual and organizational level targeting multiple health behaviors, ideally with consideration for both physical and mental components.

Integrated workplace health promotion program

An integrated WHPP, as displayed in figure 1, targeting both the individual and organizational level and multiple health behaviors simultaneously is thus potentially effective in improving the lifestyle of employees (83). An example of a successful integrated WHPP is the Lombardy Workplace Health Promotion Network (LWHPN) (83). Based on the promising results of a pilot study and successful implementation, the LWHPN is recognized as a European good practice in the occupational setting in the European Joint Action CHRODIS (84). Organizations participating in the LWHPN received a catalogue in which accessible activities on both the individual and organizational level for multiple health behaviors were included. Organizations composed their own program by selecting activities to implement within multiple health behaviors. Significant positive effects on smoking cessation and fruit and vegetable intake were observed during a one year pilot study. Favorable changes were apparent for alcohol intake and physical activity (85). In 2022 around 1,000 organizations participated in the LWHPN,

reaching a total of approximately 300,000 employees (86). Due to its success, a similar program, based on the LWHPN has been implemented in Andalusia, Spain as well (87). This approach, in which activities could be selected from a catalogue enables organizations to select and implement activities that best fit the needs, preferences and possibilities of employees and suit the organization (66, 72). Hence, it aligns with the previously defined aspect that the content of a WHPP should correspond to practical and contextual needs and resources of employees and the organization itself. Moreover, in both the Lombardy and Andalusian WHPP a working group including employees and health experts amongst others, was composed to select and implement health promoting activities. Using such a working group, the recommendation to include employees in the implementation process is met and may positively affect implementation of WHPPs (58, 59, 61).

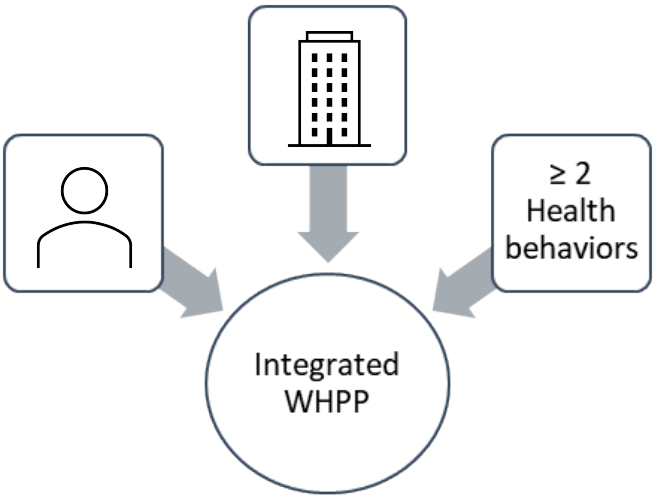

Figure 1. Overview of an integrated WHPP

Sedentary behavior and workplace health promotion

The amount of sedentary work has increased over the past years (88). The measures implemented during the COVID-19 pandemic, including working from home, have further intensified the time spent sedentary during working hours (89). The detrimental effects of sedentary behavior on both physical and mental health, components that are important for one's vitality, are well-known (90-94). This pleads for the integration of sedentary behavior in an integrated WHPP. Understanding the associations between sedentary behavior and work-related health outcomes may

provide input for the development of WHPPs that address sedentary behavior and reduce work-related outcomes such as fatigue and stress.

An example of such a work-related health outcome is the need for recovery (NFR). The NFR is a measure to indicate both physical and mental work-related fatigue (95, 96). A consistently high NFR is associated with both health related issues, i.e. cardiovascular diseases and work related issues, i.e. increased absenteeism (97-99). However, the association between (occupational) sedentary behavior and the NFR is still unknown among white collar workers, i.e. a population with high levels of sedentary work. Research, preferably with accelerometer data, on this association may provide insights that can be incorporated into WHPPs.

Relevance of this dissertation

In this study we built upon the LWHPN by tailoring it to the Dutch context. Adapting a WHPP to the context of another country is essential, as working cultures differ between countries. In order for WHPPs to be effective, they should be tailored to the context they are to be implemented in, i.e. both the national and organizational context (100). With this dissertation we aim to fill multiple gaps. First of all, the integrated WHPPs in Lombardy was only evaluated in a non-randomized controlled before-after evaluation. Extensive and thorough research into the effect and implementation process of the integrated WHPP on the lifestyle, vitality and health of employees is lacking. In this dissertation, we aim to unravel if the integrated WHPP can improve the lifestyle of employees in Dutch organizations and evaluate the implementation process. In addition, due to the increase in sedentary work and the importance of both physical and mental components in health and vitality, we aim to gain more insight in the association between occupational sedentary behavior and the NFR, a measure to indicate work-related physical and psychological fatigue.

This dissertation is relevant for both research, practice i.e. employers, supervisors, HR-professionals and employees and policy. It provides new insights on 1) factors that need to be taken into account for implementing WHPP's, 2) the effects of an integrated WHPP on the lifestyle of employees and 3) the association between occupational sedentary behavior and the need for recovery. As data for this dissertation is collected through various qualitative and quantitative research methods, a rich variety of data is gathered. Moreover, the target group i.e. employees and employers, is involved during the development and implementation of the integrated WHPP, which contributes to a WHPP tailored to the needs of employees and thereby potentially increases commitment and subsequently participation.

Objectives

The main objectives of this study were:

1. To tailor the Lombardy WHP Network to the Dutch context, in co-creation with employers and employees.
2. To evaluate the implementation process to understand the success or failure of the implementation of the integrated WHPP.
3. To evaluate the effectiveness of the integrated WHPP on lifestyle and targeted health behaviors.
4. To gain insight in the association between occupational sedentary behavior and the need for recovery in white collar workers.

Based on the abovementioned objectives, the following research questions (RQ) were answered:

1. What are the barriers and facilitators for participation in and implementation of WHPPs according to employees and employers?
2. How was the integrated WHPP implemented in organizations, how did stakeholders experience it and what were contextual factors that hindered or enhanced implementation?
3. What is the effect of the integrated WHPP on the overall lifestyle and targeted health behaviors of employees?
4. Are occupational sedentary behavior and the need for recovery associated among white collar employees?

Outline of this dissertation

Part I – The development of the integrated WHPP

In *chapter 2*, we will present the design of the study that describes the systematic tailoring and the evaluation design of the integrated WHPP.

A qualitative study towards the barriers and facilitators for participation in WHPPs according to employees was conducted. Data was collected by means of peer-to-peer interviewing. An innovative method derived from citizen science, in which participants actively take part in conducting research. Results are presented in *chapter 3* and used for the development of the implementation plan.

To gain insight in barriers and facilitators for implementation of an integrated approach for health promotion at work according to employers, focus groups were conducted. Findings are presented in *chapter 4* and were used for the development of the implementation plan.

Part II – The evaluation of the integrated WHPP

A process evaluation was conducted to gain insight in the implementation process and the barriers and facilitators for implementation of the integrated approach. Both qualitative and quantitative data were collected from different stakeholders. Findings of the process evaluation are reported in *chapter 5*.

The effect of the integrated approach on overall lifestyle of employees is evaluated in a cluster randomized controlled trial with follow-up measurements at six and twelve months. Secondary outcome measures are separate health behaviors targeted. Findings are presented in *chapter 6*.

A study towards the effectiveness of activities implemented on both the individual and organizational level within physical activity or nutrition on the health behavior targeted is presented in *chapter 7*.

Part III –Sedentary behavior and vitality

In *chapter 8*, accelerometry data were used to gain insight in the association between occupational sedentary behavior at work and the need for recovery after work among white collar workers is presented. Compositional data analysis was applied, which takes into account the ratios among activity behaviors during a workday, in particular the ratio between time spent in short sedentary bouts (0-10 minutes), medium sedentary bouts (10-30 minutes), long sedentary bouts (>30 minutes) and non-sedentary behavior (standing, walking, physical activity). This provides information for the design and content of WHPPs aimed at decreasing time spent in sedentary behavior at work.

In *chapter 9* the main results will be summarized and compared to available scientific literature. Moreover, strengths, limitations and implications for research, practice and policy are discussed. Also, recommendations for future research are presented.

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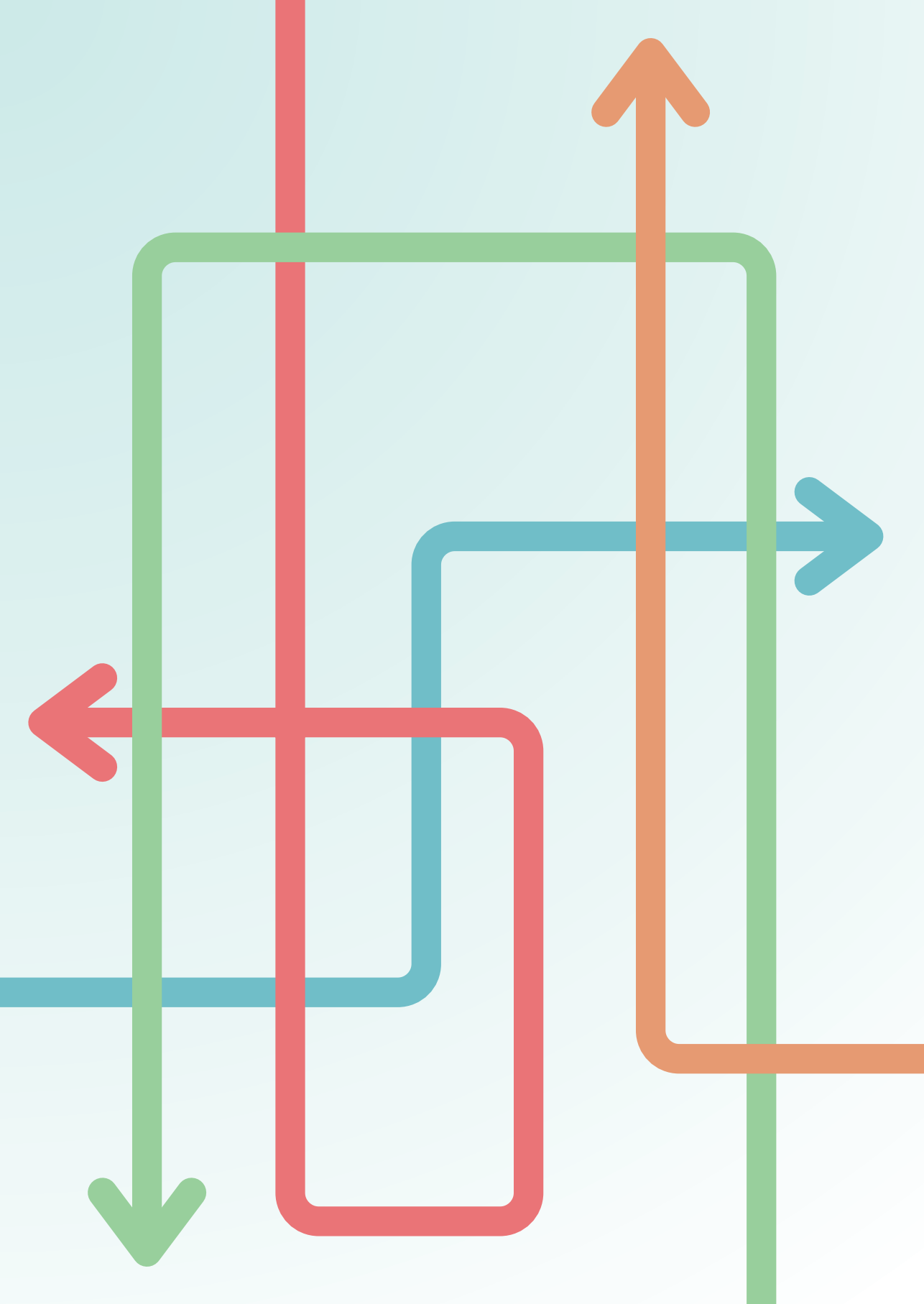

Part I

The development of the integrated WHPP


2

Chapter 2

A study protocol of the adaptation and evaluation by means of a cluster-RCT of an integrated workplace health promotion program based on an European good practice

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Abstract

Background: An integrated workplace health promotion program (WHPP) which targets multiple lifestyle factors at different levels (individual and organizational) is potentially more effective than a single component WHPP. The aim of this study is to describe the protocol of a study to tailor a European good practice of such an integral approach to the Dutch context and to evaluate its effectiveness and implementation.

Methods: This study consists of two components. First, the five steps of the Map of Adaptation Process (MAP) will be followed to tailor the Lombardy WHP to the Dutch context. Both the employers and employees will be actively involved in this process. Second, the effectiveness of the integrated Dutch WHPP will be evaluated in a clustered randomized controlled trial (C-RCT) with measurements at baseline, 6 months and 12 months. Clusters will be composed based on working locations or units - dependent on the organization's structure and randomization within each organization takes place after baseline measurements. Primary outcome will be a combined lifestyle score. Secondary outcomes will be the separate lifestyle behaviors targeted, stress, work-life balance, need for recovery, general health, and well-being. Simultaneously, a process evaluation will be conducted. The study population will consist of employees from multiple organizations in different industry sectors. Organizations in the intervention condition will receive the integrated Dutch WHPP during 12 months, consisting of an implementation plan and a catalogue with activities for multiple lifestyle themes on various domains: 1) screening and support; 2) information and education; 3) adjustments in the social, digital or physical environment; and 4) policy.

Discussion: The MAP approach provides an appropriate framework to systematically adapt an existing WHPP to the Dutch context, involving both employers and employees and retaining the core elements, i.e. the catalogue with evidence-based activities on multiple lifestyle themes and domains enabling an integrated approach. The following process and effect evaluation will contribute to further insight in the actual implementation and effectiveness of the integrated WHP approach.

Trial registration: NTR (trialregister.nl), NL9526. Registered on 3 June 2021.

Keywords: Workplace health promotion, Integrated approach, Map of adaptation process, Protocol, Cluster randomized controlled trial, Effect evaluation, Process evaluation

Background

Non-communicable diseases (NCDs) are the leading cause of death worldwide (1, 2). Unhealthy lifestyle behaviors are well-known modifiable risk factors of NCDs. Therefore, promotion of a healthy lifestyle is of importance (3, 4). The workplace is seen as an appropriate setting to promote health including the improvement of a healthy lifestyle (5, 6). Workplace health promotion programs (WHPPs) can be effective in improving the lifestyle behaviors targeted (7-10). For instance, a review of reviews by Proper et al. concluded that WHPPs have a positive effect on both body weight-related outcomes and the prevention of mental and musculoskeletal problems (7). However, it should be acknowledged that in some of these systematic reviews, evidence was limited to moderate (8-10). Individual participant data meta analyses from Robroek et al. and Coenen et al. even showed that overall there was no statistically significant effect of WHPPs on BMI, physical activity, alcohol consumption, smoking and diet, with the exception of fruit intake (11, 12). Most interventions included in these reviews focused on the individual or environmental level only. The abovementioned findings indicate that there is a need for new directions in the design of WHPPs (11, 13). A greater impact on lifestyle and health can be expected from an integrated approach, which targets the individual level as well as the organizational level (14). Earlier studies have indeed shown greater effects of WHPPs that focus on an environmental component in addition to individually based components on the targeted lifestyle behaviors (8, 15, 16). Nevertheless, these interventions often include only minimal environmental changes. More extensive environmental changes are necessary (13). A good example of a successful integrated WHPP is the Lombardy WHP Network, which is recognized as a good practice in the occupational setting in the European Joint Action CHRODIS because of its integrated approach and successful implementation (14, 17). This program has been implemented in Lombardy, Italy, where participating organizations received a catalogue in which activities on both the individual and organizational level for multiple lifestyle themes are included. Employers chose which activities to implement at both the individual and organizational level. A pilot study with a follow-up of 1 year showed significantly positive effects on smoking cessation and fruit and vegetable intake, and favorable changes were apparent for alcohol intake and physical activity (18). The Lombardy WHP Network was further successful in the implementation and participation of organizations (19). Development of the program started in 2011 in Bergamo, and in 2013 it expanded on a regional scale. In 2014, 284 workplaces, employing 139,186 persons, were involved (14, 19). The catalogue with evidence-based activities was continuously updated, which also contributed to the success

of the Lombardy WHP Network (19). The catalogue may also have played a role in the successful implementation, due to the wide range of small and accessible WHP activities provided, an integrated approach that fits the organization can be composed. Such a WHPP is possibly easier to implement when compared to an imposed extensive WHPP. A similar integrated WHPP, based on the Lombardy WHP Network, has been implemented in Andalusia, Spain (20). Initial results after a nine-month implementation period showed no statistically significant changes yet, but the frequency of sweets consumption within one organization declined with 6.2% (10.8% vs 4.6%) and physical activity in the same organization increased with 12.3% (23.1% vs 35.4%) (21). Currently there is a lack of such integrated WHPPs and scientific evidence about their effectiveness and implementation (13). Because of the integrated approach, successful implementation and effects on lifestyle behaviors, our aim was

to describe the protocol of a study to tailor the integrated European good practice Lombardy WHP Network to the Dutch context and to evaluate its effectiveness and implementation by means of a cluster randomized controlled trial. This paper describes two components: 1) the protocol of the systematic tailoring of the Lombardy WHP Network to the Dutch context, and 2) the design of the effect and process evaluation.

Methods/design

For the first component of this study, the protocol of the systematic tailoring of the Lombardy WHP Network, the Map of Adaptation Process (MAP) will be followed. The MAP is a stepwise and systematic approach for the adaptation of an evidence-based behavioral approach to new contexts (22). The MAP allows a bottom-up approach, in which stakeholders, such as the employers and employees, will be involved in the different steps (23). Hence, the program can be tailored to their needs and preferences. The MAP consists of five steps: 1) assessment of relevant lifestyle themes, potential barriers and facilitators for implementation and participation, potential activities to be included in the catalogue and the formulation of criteria for an integrated WHPP in the Dutch context, 2) selection of the final content for the Dutch context adapted catalogue, 3) preparation of the catalogue for implementation, 4) pilot test of the feasibility and comprehensiveness of the implementation plan, and 5) implementation of the program (Fig. 1).

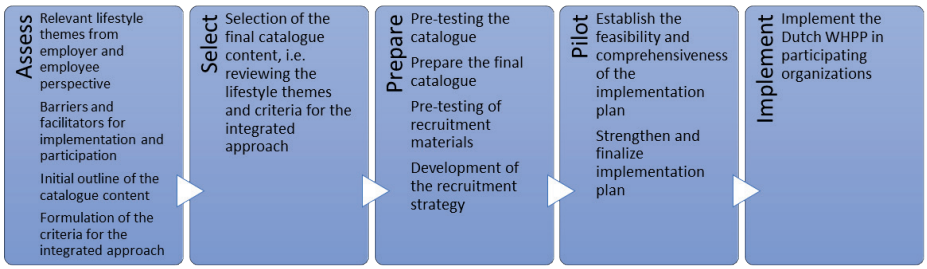

Figure 1. Steps from the Map of Adaptation Process.

Tailoring of the Lombardy WHP network to the Dutch context

Step 1. Assess

Based on the Lombardy WHP Network, the Dutch WHPP will consist of a catalogue along with an implementation plan to support successful implementation. For the development of the catalogue, lifestyle themes relevant for both the employers and employees will be established. Also, potential barriers and facilitators for implementation of and participation in WHP activities will be identified, these will be used to develop the implementation plan. The catalogue will consist of effective activities to improve lifestyle, an initial draft for the catalogue content will be comprised. Criteria that organizations must fulfill in order to implement activities according to integrated approach in the Dutch WHPP will be formulated. To identify the relevant lifestyle themes and the barriers and facilitators for implementation of and participation in WHPPs, focus groups with employers and peer-to-peer interviews with employees will be conducted. Focus group will be carried out with managers, HR professionals and prevention workers, whom in this study represent the employers' perspective. A variety of organizations with both blue collar and white collar employees will be represented in these focus groups. In addition, peer-to-peer interviews, in which employees interview their co-workers will be conducted. Peer-interviewers will be recruited within different organizations and departments, to ensure they represent various job types and educational levels. Peer-to-peer interviewing is a method derived from citizen science, in which participants actively take part in conducting research (24). Advantages are an efficient data collection and less socially desirable answers as persons are considered to respond more genuinely to their peers (24-26).

A toolkit with WHP activities, developed in 2020 within the Joint Action CHRODIS PLUS (27), will be used as a starting point for the initial draft of the catalogue content together with results from the focus groups and peer-to-peer interviews. The WHP activities will be tailored to the Dutch context.

The criteria of the integrated approach in the Dutch context will be formulated by the researchers based on the definition for an integrated approach of the Lombardy WHP Network and the definition of other Dutch integrated health promotion programs developed by the National Institute of Public Health and the Environment, Center of Healthy Living (28, 29). Within these integrated programs the individual level and organizational level are further specified into four domains. The individual level is subdivided into two domains, i.e. 1): screening and support, where identification of lifestyle related issues and support in addressing these issues is key and 2) information and education, which focuses on creating awareness about the importance of a healthy lifestyle. The organizational level also consists of two domains: 3) adjustments in the social, digital or physical environment to support a healthy lifestyle and 4) policy adjustments to facilitate and encourage a healthy lifestyle. The present study will follow this definition for an integrated approach (Fig. 2). This definition will also be used to formulate the criteria for the integrated approach.

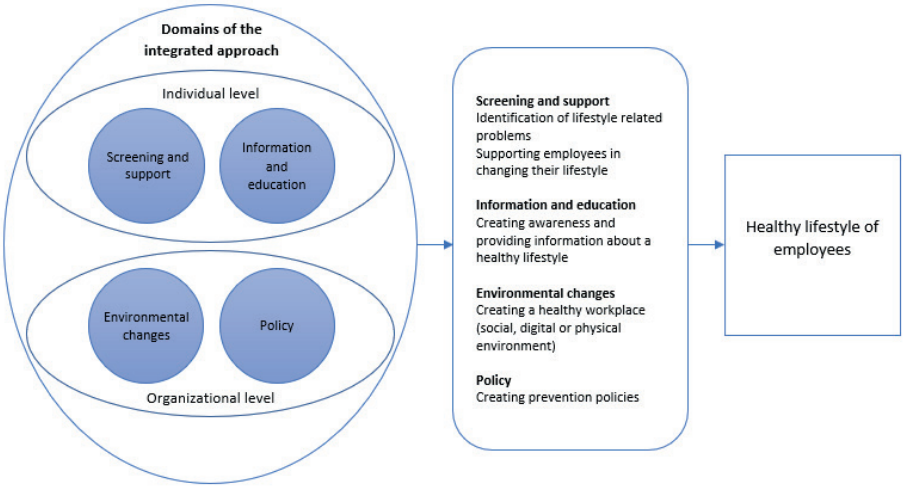

Figure 2. Model of the integrated approach.

Step 2. Select

The aim of the second MAP step is to discuss the lifestyle themes, derived from the focus groups and interviews in step 1, to be included in the catalogue and the criteria of the integrated approach. This will be done with an advisory board, during a group meeting. The advisory board exists of representatives of employees, employers, the Ministry of Health, Welfare and Sport, and the Ministry of Social Affairs and Employment, as well as experts from the Center for Healthy Living and

National Institute for Public Health and the Environment. If necessary, themes will be renamed or reclassified, and criteria will be adjusted. With this information, the initial draft of the catalogue will be adapted.

Step 3. Prepare

During the preparation step the catalogue will be finalized and a cluster randomized controlled trial (C-RCT) will be prepared. In doing so, the catalogue will be pretested by a working group of managers and supervisors from an organization that is experienced in implementing WHP activities. This is also one of the organizations that will participate in a focus group. The working group will verify the fit of the materials to the organization and staff and they will be asked to critically review the materials and provide feedback on attractiveness, readability and understanding of the instructions. In doing so, the working group will jointly fill in a checklist. If necessary, one representative of the working group will elaborate on this completed checklist during a conversation with the researcher. Information from the checklist and conversation will be used to make changes to the materials and to finalize the catalogue. In preparation for the C-RCT, HR professionals, management, prevention workers and employees from each organization that will participate in the C-RCT will form a practice group which will review recruitment materials, promotion materials and presentations. The practice group will also support in the recruitment of workers to participate in the C-RCT by providing information and creating support among employees.

Step 4. Pilot

The implementation plan describes the key elements for implementation of WHP activities and describes necessary resources and relevant persons within the organization that should be involved in the implementation. A pilot-test will be conducted by the working group that also was involved in step 3, to assess the feasibility and comprehensiveness of the draft implementation plan. The working group will be asked to select one activity from the catalogue to apply the implementation plan to. The working group will go through all steps of the implementation plan as if they are implementing the activity. However, the activity will not actually be implemented. The working group will express their views on the comprehensiveness and feasibility of all elements of the implementation plan according to a checklist. A representative of the working group and a researcher will discuss the provided feedback based on the completed checklist if necessary. Information retrieved from the checklist and discussion will be used to adjust and finalize the implementation plan.

Step 5. Implement

Several organizations will participate in the C-RCT to evaluate the Dutch WHPP. As part of the evaluation, the program will initially only be implemented in a randomly selected half of the participating departments or locations, depending on the structure of the organization. The remaining participating departments or locations will serve as a waiting list control condition and will receive the WHPP once the trial has ended.

Evaluation plan

For the second component of this study, the design of the effect and process evaluation will be described.

Study population

Dutch organizations will be recruited via the extensive network of the project team members, co-workers and branch specific networks. Inclusion criteria for participants will be: working within the participating organizations for at least 12 hours per week with a contract until the final measurement, including employees with a flexible contract or self-employed persons, who have a contract with the organization for 12 or more hours per week. Exclusion criteria will be: being on sick leave for more than 4 weeks or pregnancy.

Recruitment

To recruit and inform employees, different communication channels, such as intranet, newsletters, posters, videos and flyers, will be used. Workers within the participating organizations are invited for an information session, which will be either at the workplace or online. The practice group will distribute an information letter and recruitment materials among the employees approximately 4 weeks prior to the start of the C-RCT. Additionally, the practice group will distribute a link by mail or through newsletters, among their employees, so that employees can obtain more information and/or express their interest in the study to the researchers prior to the information session. Employees who expressed their interest will receive information, an eligibility checklist and informed consent by post. During the information sessions, researchers will explain the study purpose and design. At the end of the session, employees can ask questions to the researchers. Again, the link which employees can use to express their interest in the study will be distributed. Employees can send the signed informed consent and completed eligibility checklist prior or after the information session by post to the researchers, with a return envelope that they receive together with the informed consent. 2–4 Weeks after the information session the baseline measurement will take place for employees who are eligible and returned a signed informed consent.

Effect evaluation

Study design

The effectiveness of the Dutch WHPP will be evaluated in a two-armed C-RCT with a follow-up duration of 12 months. Clusters will be composed based on working locations or units - dependent on the organization's structure -, to reduce contamination between the control condition and intervention condition (30). Clusters in the intervention condition will receive the WHPP, consisting of the catalogue and implementation plan, and are asked to implement activities following the criteria of the integrated approach. Continuation of already implemented WHPPs in organizations is permitted in both the control condition and intervention condition. The Medical Ethical Committee of the VU University Medical Center (VUmc, Amsterdam, the Netherlands) approved the study protocol (2021.0402). The trial is registered in the Netherlands Trial Register (NTR) under the number NL9526. Important amendments of the protocol will be communicated to all relevant parties, i.e. the Medical Ethical Committee of the VU University Medical Center (for review and approval), participating organizations, trial registry, participants and journals. Furthermore, adverse events will be reported to the Medical Ethical Committee of the VU University Medical Center. Representatives of the department of Quality, Occupational Health and Safety, and Environment of the RIVM and/or representatives of the Ethics Committee may select this project to undergo an audit. Topics of such an audit may be the progress of the study, the planning, potential highlights and/or problems. The results of this study will be disclosed unreservedly and will be presented as articles in scientific (peer-reviewed) journals and presentations at scientific conferences.

Randomization and blinding

Randomization within each organization will take place at cluster level and after baseline measurements. Two independent researchers will be involved in the randomization process. The first independent researcher will assign consecutive numbers to all of the clusters within an organization. The second independent researcher will receive this list without being informed about which number corresponds with which cluster. This researcher will use a computer program to randomly assign the numbers to the intervention or control condition (31). The first independent researcher will receive the list with numbers and their allocation to the intervention or control condition and will link this to the clusters within the organization. Then, the research team of the current study will send the program to the clusters in the intervention condition. However, the researcher involved in the data processing and analyses will be blinded for group allocation, because clusters will be recoded by an independent researcher prior to analyses.

Sample size calculation

The sample size needed for the proposed study was based on finding an effect on the primary outcome, a combined lifestyle score as measured using the Simple Lifestyle Indicator Questionnaire (SLIQ) (32). The sample size calculation was carried out including cluster correction using an estimated intracluster correlation coefficient (ICC) of 0.04 (33). Based on a mean score of 7.02 (standard deviation of 1.5) on a scale of 0–10, a power of 80%, a two-sided alpha of 0.05 and an estimated number of 6 clusters per condition, 264 participants (132 per group) are needed to statistically demonstrate an effect on lifestyle of 10%. Taking into account a loss to follow-up of 20% after 12 months, a total of 330 employees (2 groups of 165) need to be included.

Measurements

Participants in both conditions receive online questionnaires at baseline, and at 6 and 12 months of follow-up. Additionally, a subgroup of the participants will be asked to wear a triaxial accelerometer for 7 days at baseline and 12 months (Fig. 3). The study population will include participants from various educational backgrounds. To ensure that all participants, including those with low (health) literacy, will be able to understand and complete the questionnaire, the questionnaire will be simplified. To maintain the validity of the questionnaire, the nature of the questions will not be adjusted. Words that might be difficult to read or understand will be replaced by better readable and understandable words.

Handling and storage of data

Data will be collected by online questionnaires and triaxial accelerometry. Data will be handled confidentially and in compliance with the General Data Protection Regulation (in Dutch: AVG). Raw anonymized data from the accelerometers will be analyzed by the UKK Institute in Finland, a processing agreement is drawn up and signed for this purpose. Facilities for storage and back up of the data of the National Institute of Public Health and the Environment (Rijksinstituut voor Volksgezondheid en het Milieu) will be used. Daily backups are made. To ensure confidentiality, data will be pseudonymized. The unique pseudonym for every participant will not be based on the participant's initials and birth date. A secured database, only accessible for the RIVM researchers involved in this study, will include the link between personal data and the specific pseudonym. At the end of the project, contact data and names of participants will be deleted form this database. Other data will be preserved for 15 years after the project ended. Due to the expected absence of (high) risks for participants of this study, the establishment of a data monitoring committee is not necessary.

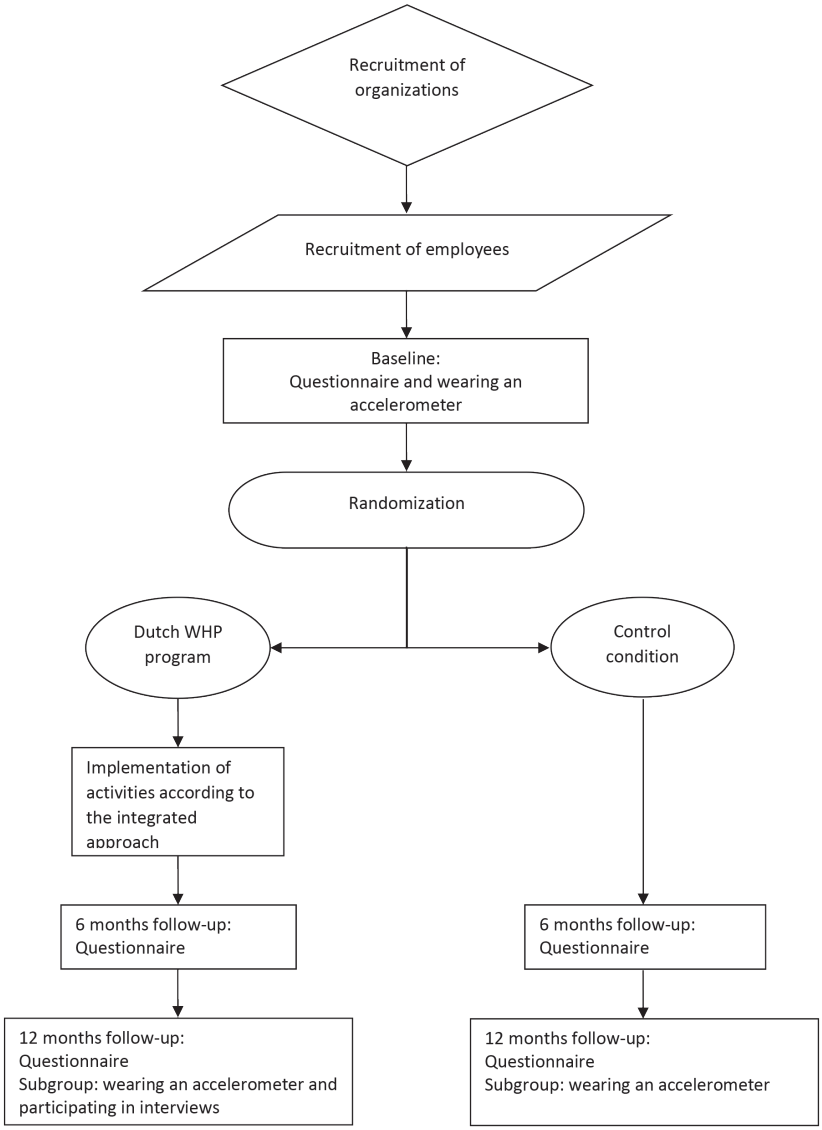

Figure 3. Time schedule of the C-RCT.

Primary outcome measure

Lifestyle

Overall lifestyle behavior will be measured with the reliable and validated Simple Lifestyle Indicator Questionnaire (SLIQ) (32, 34). The SLIQ provides a global lifestyle score and consists of five components: nutrition (3 questions), physical activity (3 questions), alcohol consumption (3 questions), smoking status (2 questions), and stress (1 question) (32). The Cronbach alphas measured for nutrition and physical activity were 0,58 and 0,60 respectively (32). As the SLIQ is only available in English it will be translated to Dutch according to the back translation method, derived from the guidelines of Guillemin et al. (35). Two translators will independently translate the SLIQ from English to Dutch. An independent translator and one of the researchers (DS) will compose a consensus version. This Dutch translation will be back translated to English by two other translators, who are unaware of the original SLIQ. Again a consensus translation will be composed by the same independent translator and researcher. The original SLIQ and the back translated English version will then be compared and changes will be made to the Dutch SLIQ if necessary. Furthermore, cultural adaptations will be made, e.g. examples of physical activity will be adjusted if a sport is not common in the Netherlands. For each lifestyle component in the SLIQ, a score of 0–2 is assigned yielding a total score of 0–10 for the overall lifestyle score, where 0 stands for the most unhealthy lifestyle and 10 the most healthy lifestyle possible.

Secondary outcome measures

Secondary outcome measures include physical activity (both occupational and non-occupational), nutrition, sleep, stress, work-life balance, need for recovery, perceived general health, and well-being.

Physical activity

A subgroup of participants in both the intervention and control condition will be asked to wear a triaxial accelerometer (RM42 or Actigraph GT9X Link) to objectively measure physical activity at baseline and at 12 months. Participants will wear the same accelerometer at baseline and 12 months. Total minutes of both occupational and non-occupational light, moderate and vigorous activity per day will be measured as well as total minutes of occupational and non-occupational sedentary behavior, i.e. sitting and lying, and number of breaks from sitting per day. Participants will be asked to wear the accelerometer device for 24 hours on 7 consecutive days on their hip (36). They will also keep a diary to note the date, wearing time, sleep time, working time, and time spent cycling or exercising. Raw

acceleration data measured will be analyzed by using the validated mean amplitude deviation (MAD) and angle for posture estimation (APE) algorithms or the Actilife 6 Software (37-39). Additionally, the valid and reliable Short QUestionnaire to Asses Health-enhancing physical activity (SQUASH) will be included in the questionnaire at baseline, 6 and 12 months (40). The SQUASH questionnaire measures habitual physical activity levels during a regular week in the past month of four different physical activity domains: commuting, occupational, household and leisure time (40). For each domain, employees will be asked to indicate the frequency (days per week), self-reported intensity (light, moderate or vigorous) and average duration (hours and minutes) of the activity per day. For each domain, activities will be subdivided into three age-dependent intensity categories (i.e., light/moderate/vigorous), corresponding to the metabolic equivalents (METs) derived from Ainsworth's compendium of physical activities. Total minutes per week of moderate-to-vigorous physical activities will be calculated by summing the time spent on at least moderate intensity activities across the three domains of commuting, household and leisure time. Moreover one question regarding sedentary behavior will be added, to gain insight in the time spend sitting on an average day (hours and minutes).

Nutrition

Nutrition will be measured using six questions derived from the PIAMA Birth Cohort study (41). One question focuses on the average amount of sugary drinks consumed per week during a regular month. The other questions involve consumption of small and large snacks, both sweet, savory and deep-fried, measuring the average amount of snacks consumed per week during a regular month.

Sleep

The Medical Outcomes Study Sleep scale (MOSSS), a reliable and valid measurement instrument, will be used to assess important aspects of sleep perceived by participants (42). In total eight aspects of sleep can be measured with the MOS-SS. For this study four aspects will be measured, i.e. sleep quantity, optimal sleep, sleep disturbance, and somnolence. Sleep quantity is scored by the average hours of sleep per night for the last 4 weeks. When a participant reports 7–8 hours of sleep, it is considered as optimal sleep, which leads to a score of 1 on this scale, more or less hours of sleep lead to a score of zero. Sleep disturbance and somnolence are scored on a 6 point scale and converted to a score between 0 and 100, in which a higher score indicates more of the concept being measured. In addition, sleep quantity, time to fall asleep and waking up during sleep will be measured using the triaxial accelerometer.

Stress

Stress will be measured using the stress sub-scale of the short version of the Depression Anxiety and Stress Scale (DASS-21) (43). The stress sub-scale of the DASS-21 consists of seven statements, measuring overall stress during the past week. Responses will be summed into a scale score ranging from 0 to 21, with a higher score representing more stress. Validation of the DASS-21 has been performed in a non-clinical setting (44). The Cronbach alpha measured for stress was 0,84 (44).

Work-life

*balance*The work-life balance will be measured by the short version of the negative work-home interference scale of the Survey Work-home Interference Nijmegen (SWING), a valid and reliable instrument with a Cronbach alpha of 0,85 (45, 46). This scale consists of 4 items for which participants are asked to indicate how often their work-life negatively interferes with their home-life on a 4-point scale (0–3). Scores will be summed and averaged, resulting in a score between 0 and 3, in which 3 is the most negative work-home interference possible.

Need for recovery

Need for recovery will be measured using the corresponding subscale of the Questionnaire on the Experience and Evaluation of Work (47) The need for recovery scale is valid for the measurement of (early symptoms of) fatigue after work and a Cronbach alpha of 0,88 was measured (48). The scale consists of 11 questions to be answered on a dichotomous scale (yes/no). The total score is standardized to a score between 0 and 100, in which 100 represents the highest need for recovery.

General health

Perceived general health will be measured using the subscale 'general health perceptions' of the RAND-36, which is a widely used and validated instrument to measure health-related quality of life (49). The Cronbach alpha of the general health perception subscale was 0.81 (49). General health is measured by 5 items on a 5 point scale. Answers will be coded, summed, and then transformed to a 0 to 100 scale with a higher score indicating a better health status.

Well-being

Well-being will be assessed by the 5-item World Health Organization Well-Being Index (WHO-5), which has shown good construct validity in various settings (50). The questionnaire consists of five statements to be answered on a 6 point rating scale (0–5). The total score (0–25) is multiplied by 4 to achieve a scoring of 0–100 where 100 represents the best imaginable well-being.

Potential confounders and effect modifiers

Data on potential confounders and effect modifiers will be assessed by questionnaire including age, gender, highest educational level attained, marital status, type of work (blue/white collar), working conditions (i.e. working from home), and working days and hours per week.

Data analysis

First, descriptive statistics (means, standard deviations, or frequencies) at baseline will be performed for all relevant variables. The effect of the Dutch WHPP on the primary and secondary outcomes will be determined by performing longitudinal linear mixed models, adjusting for baseline differences of the outcome measure. Differences in the primary and secondary outcomes at 6 and 12 months between the WHPP condition and the control condition will be analyzed. Main analyses will be performed following the intention-to-treat principle including all available data of the participants regardless their compliance to the program.

Process evaluation

Study design

To understand the success or failure of the implementation of the integrated Dutch WHPP and its activities, a process evaluation will be conducted among the clusters in the intervention condition. Two process evaluation models will be combined, as these complement each other (51, 52). Using the framework of Wierenga et al. (2012), recruitment, reach, dose delivered, dose received, fidelity, satisfaction, maintenance and context will be evaluated. As implementation strategy and participants' mental models are expected to play an important role in the success or failure of the implementation, these components from the framework of Nielsen and Randall (2013) will be added to the initial framework. Data will be collected by means of mixed methods, combining quantitative and qualitative methods.

Measurements

A monitoring chart will be completed by the employer during the whole 12-month follow up. This monitoring chart collects information on the implemented WHP activities, time needed for preparation of implementation, the way employees were informed about the activities and in case of individual-based activities, the number of sessions and attendance of employees. At 6 months and 12 months follow up, questions regarding process outcomes will be included in a questionnaire for employees. Observations at the workplace will take place at baseline and between

10 and 12 months follow up, to observe which environmental activities were implemented and to see if employees were stimulated to participate in visible manners, i.e. posters and flyers. Additionally, interviews with employers and employees about the implementation process will be conducted between 10 and 12 months follow-up. The following process indicators will be measured:

Recruitment
Provides insight into the sources and procedures used to approach and stimulate employees to participate. Recruitment will be measured by observations at the workplace, a monitoring chart, interviews with employers and questionnaires among employees.

Reach
The proportion of employees who were aware of the integrated Dutch WHPP and the activities implemented at the workplace. Reach will be measured by means of questionnaires among employees.

Dose delivered
The proportion of the intended Dutch WHPP activities that is delivered by the employer to the employees. This component will be measured with the observations at the workplace and the monitoring chart.

Dose received
The extent to which employees were engaged in the Dutch WHPP activities. The dose received will be measured by means of the monitoring chart and questionnaires.

Fidelity
Compliance to the criteria of the integrated approach and compliance to the implementation plan will be measured. Information will be collected by conducting interviews with employers and the monitoring chart.

Satisfaction
The opinion and satisfaction about the Dutch WHPP. Employees will grade the program in the questionnaires and further information will be collected by means of interviews with employees.

Maintenance
The degree to which the activities and the integrated Dutch WHPP are continued within the organization. Information concerning this component will be collected by means of interviews with employers.

Context
Determinants of implementation which can either hinder or facilitate the implementation of the Dutch WHPP and its activities. Information on this component will be yielded by means of questionnaires and interviews with employers and employees.

Implementation strategy
The roles and behaviors of the key stakeholders e.g. support from management to participate in WHP activities and the perceived degree of employee involvement in the implementation of the integrated Dutch WHPP and its activities. Information will be yielded by interviews with the employers and employees and the monitoring chart.

Participants' mental models
Perceptions and appraisals from the employees and employers about the integrated Dutch WHPP and its activities. It defines how employees and supervisors respond to the activities and identifies whether potential conflicting agendas may influence the behaviors and outcome of the Dutch WHPP. Information will be collected by means of interviews with employees and employers and questionnaires.

Data analysis
For the questionnaires, monitoring charts and systematic observations descriptive analyses will be performed and presented in mean (SD) and percentages, this includes the recruitment, reach, dose delivered, dose received, fidelity, satisfaction, context, implementation strategy and participants' mental models. Satisfaction of the Dutch WHPP will be assessed using a rating scale of 0–10, in which 0 indicates the lowest satisfaction possible and 10 the highest satisfaction. To determine dose received we will calculate 1) the percentage of employees that had participated at least once in an individual-based activity, 2) the percentage of employees who indicated that they made use of or were exposed to an environmental activity, and 3) the percentage of employees that fulfils 1 and 2 and is therefore seen as being compliant to the integrated WHPP, i.e. they received the complete intervention. The interviews will be recorded and transcribed verbatim. Transcripts will be coded independently by two researchers by means of thematic coding. This

analysis includes the constructs context, fidelity, maintenance, implementation strategy and participants' mental models. To evaluate the context component, the Consolidated Framework for Implementation Research will be used. Analyses will be done using MAXQDA.

Discussion

This paper describes the protocol of tailoring the Lombardy WHP Network to the Dutch context and the design of the effect and process evaluation. The Lombardy WHP Network has shown promising results in the improvement of lifestyle behaviors of employees and has been successful in the implementation of integrated activities in order to stimulate a healthy lifestyle among their employees (18). These results, especially regarding the successful implementation and participation, are promising, since poor reach of target groups and poor implementation are common among WHPPs and weaken the potential effect (5). An integrated approach and the availability of a catalogue, where an employer can choose the activities that best suit the organization and its staff, are expected to be effective and successful in implementation. Therefore, a valid translation, retaining the core elements of the Lombardy WHP Network, i.e. the catalogue and the integrated approach, is important to create a successful Dutch WHPP. The MAP is a systematic approach that assists in adapting and tailoring interventions, while retaining core elements of the original intervention (22). Multiple other interventions, often aimed at HIV prevention, have been adapted using the MAP approach and have been found effective (53, 54). Therefore, the proposed use of the MAP is seen as a strength. It guides researchers systematically through the five stages of adaptation, which allows for sufficient documentation and a clear overview.

The bottom-up approach, where employers and employees will take part in the development of the catalogue and implementation plan that will be applied is another strength of the proposed study. This approach ensures that the adapted program suits the target population, the employers and employees. Their input will be taken into account during the different steps of the adaptation. They will provide information about relevant lifestyle-themes and potential barriers and facilitators and pretest the materials that will be used. In addition, an advisory board will be involved in several steps of the process, accounting for information and feedback from several relevant perspectives. However, the program will be specifically tailored to the organizations participating in this study. Even though

we aim for participating organizations to vary in sector, we cannot guarantee wide application in other organizations and other sectors.

The chosen study design for the effectiveness evaluation, i.e. a C-RCT, is common in public health research (55, 56). However, it comes with methodological limitations, such as risk of selection and dilution bias and participants within one cluster that tend to be more alike compared to participants in other clusters, and can therefore not be assumed to be independent (30, 57). In this study we account for this in the design by letting recruitment take place before randomization of the clusters and in the analysis by performing longitudinal multilevel analyses according to the intention-to-treat principle (57, 58). The study design allows for single blinding, in which the researcher involved in the analyses will be blinded for group allocation. This is a strength of the proposed study.

Overall, literature regarding the adaptation of WHPPs is scarce. Therefore, a process evaluation is valuable as it will provide insight into the success as well as failure aspects of the translation to the Dutch WHPP and its implementation (59). Results from the process evaluation can thus be used to further improve the implementation plan, that is part of the Dutch WHPP, and to improve program outcomes (60).

The Lombardy WHP Network, an integrated approach for health promotion at the workplace is proven to be effective in the improvement of lifestyle behaviors. However, further scientific evidence about the effectiveness of an integrated approach in the occupational setting is scarce. Following the MAP approach, the good practice Lombardy WHP Network will be systematically tailored to the Dutch context, retaining its core elements. Next, effectiveness and process of implementation will be evaluated. This proposed study to the effectiveness and implementation process of the tailored integrated Dutch WHPP will contribute to filling the gap in literature and practice regarding integrated WHP approaches.

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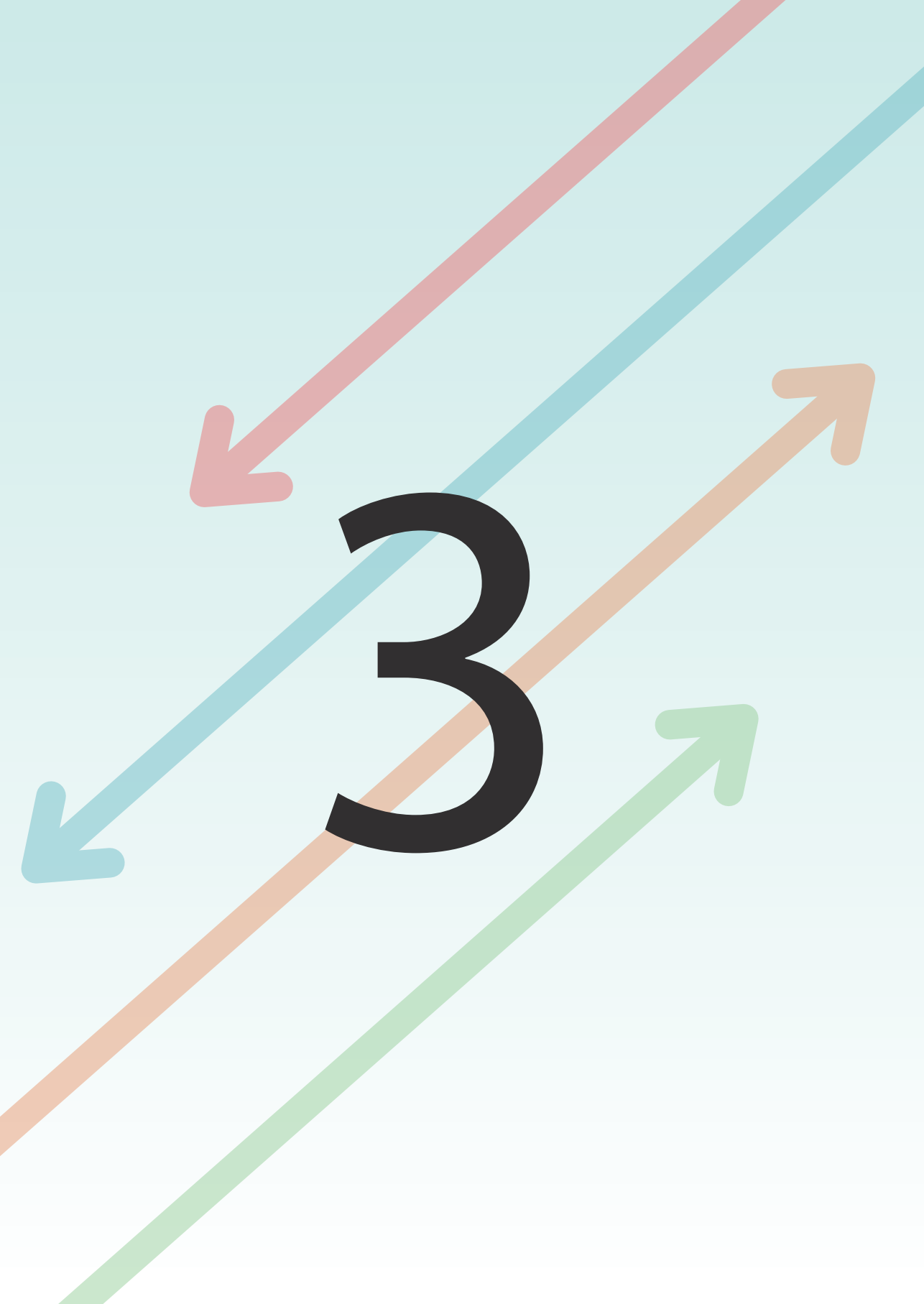
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Chapter 3

Barriers and facilitators for participation in workplace health promotion programs: Results from peer- to-peer interviews among employees

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Abstract

Objective Workplace health promotion programs (WHPPs) have shown to be effective in improving lifestyle behaviors of employees. Despite potential benefits for employees, participation rates are generally low. The aim of this study was to gain deeper insight into barriers and facilitators for participation in WHPPs prior to implementation according to employees.

Methods Peer-to-peer interviewing, a method derived from citizen science, was used to actively involve employees in the data collection. Employees working in the cleaning-, ICT- and facility-sector were trained to interview their co-workers. Interviews were recorded and transcribed verbatim. Thematic analysis was performed using the Consolidated Framework for Implementation Research (CFIR), complemented with the constructs 'interpersonal factors' and 'intrapersonal factors' from the social ecological model. Data were coded deductively and inductively, and rated by two researchers independently.

Results Fourteen peer-interviewers conducted 62 peer-to-peer interviews. Main barriers for participation in WHPPs were an unsupportive organizational culture where lifestyle is not a common topic and programs that are not tailored to their needs. Support from peers and supervisors were facilitators. The availability of organizational resources, such as facilities and financial compensation, support participation.

Conclusions To enhance participation of employees in WHPPs it is recommended to take into account the barriers and facilitators identified in this study. For instance, employees should be involved in the development and implementation of WHPPS by the employer and their needs and available resources should be taken into account. This may lead to more successful implementation and higher participation rates in future WHPPs.

Keywords: Employees, Integrated workplace health promotion, Peer-to-peer interviews, Participation, Consolidated Framework for Implementation Research, Social ecological model

Introduction

The workplace is an ideal setting to promote a healthy lifestyle, among others as it can reach a large group of adults and because of existing infrastructures for interventions (1, 2). Employers can implement health promoting activities on top of their legal responsibility to secure sustainable working conditions for their employees. Effectiveness of workplace health promotion (WHP) on several targeted lifestyle behaviors such as diet, physical activity, and psychological health is demonstrated in multiple studies (3-6). Employees can benefit in terms of improved lifestyle, and eventually improved health. WHP programs (WHPPs) have proven to be effective in weight loss, increased psychological wellbeing and perceived health of employees (3, 6, 7). Despite the potential benefits for employees, reported participation rates of WHPPs vary greatly. Robroek et al. found that participation levels varied from 10 to 64%, with a median of 33% (2). Low levels of participation can negatively affect the effectiveness and cost-effectiveness of WHPPs and limit their reach and impact (2, 8, 9). Both adequate implementation and high levels of participation are crucial factors for the effectiveness of a WHPP (2, 8-10).

Multiple barriers and facilitators for participation in existing WHPPs have been reported (2, 11-14). Earlier barriers identified were related to the employees' responsibility of a healthy lifestyle, a lack of time and the preference to improve lifestyle in one's own time (11-14). Factors that had a positive impact on participation were a program that focused on multiple lifestyle themes and a multicomponent program, e.g. a program with both an individual- and an environmental approach (2). A positive attitude of employees towards WHPPs and high levels of support were associated with a positive intention towards participation in WHPPs (12, 14). Recent qualitative studies towards barriers and facilitators for participation were not directly from an employees' perspective, but for example from a managers' or occupational physicians' view (13, 14). This implies that there is a need to expand the body of knowledge about barriers and facilitators for participation from an employees' perspective.

Adequate implementation of WHPPs can positively influence participation rates. Implementation can be improved when (1) barriers and facilitators are identified during the pre-implementation phase and (2) when employees are actively involved in the implementation and design of the program (9, 11, 14-21). In practice, barriers and facilitators for participation in a WHPP are often collected after program implementation (11, 13, 14). Preferably, barriers are known prior to implementation, so strategies to overcome these barriers can be developed

beforehand. To further improve implementation, a citizen science method can be applied to actively involve employees (18, 22, 23). This engagement can be created on various levels, for instance, participants can provide data collection (22).

This study was conducted during the development of an integrated WHPP in which a good example of a successful integrated WHPP, the Lombardy WHP Network (LWHPN), was tailored to the Dutch context (24). The LWHPN is recognized as a good practice in the occupational setting in the European Joint Action CHRODIS because of its integrated approach and successful implementation (25-27). Integrated WHPPs target multiple lifestyle themes at both the individual and organizational level (28). Previously reported barriers and facilitators were often found for programs that focused on one specific lifestyle theme and not for integrated WHPPs (2, 13). The aim of this study was to gain deeper insight into barriers and facilitators for participation in WHPPs according to employees prior to the implementation of an integrated WHPP. This involves factors at both the organizational and individual level that may facilitate or hamper participation in WHPPs according to employees. Insight into these barriers and facilitators might help to increase participation of employees in the integrated WHPP and future WHPPs.

Methods

Study design

For this study we used a qualitative design, employing peer-to- peer interviews. Peer-to-peer interviewing is a method derived from citizen science, which means that participants actively engage in carrying out research (22, 23). Peer-to-peer interviews have several benefits, such as efficient data collection and participants are considered to respond more genuinely to their peers, which leads to less socially desirable answers (23, 29, 30). Data were collected between October 2020 and January 2021.

The Center for Clinical Expertise of the Dutch National Institute of Public Health and the Environment classified the study as exempt from ethical review as it did not meet the criteria of the Medical Research Involving Human Subjects Acts. The center approved the study protocol (study number VPZ-458). Informed consent was obtained from all interviewees and the peer-interviewers.

The integrated WHPP

The integrated WHPP to be implemented exists of (1) a catalogue with health promoting activities on multiple levels (individual and organizational) and multiple lifestyle themes (physical activity, nutrition, relaxation, smoking, work-life balance, alcohol consumption, stress and sleep) and (2) an implementation plan to support successful implementation (24). The choice for these lifestyle themes was based on relevance according to both employers and employees. Examples of activities in the catalogue on the individual level are dissemination of information (e.g. about the importance of a healthy diet, a healthy work-life balance and smoking cessation), deploying exercise challenges or providing tools to monitor lifestyle (activity tracker, nutrition app). Examples of activities on the organizational level are adjustments to the working environment (offering healthy foods in the company restaurant, availability of sit-stand desks) or to the social environment (managers as role models, small social events, such as coffee breaks). Potential barriers and facilitators for implementation and participation were used to develop the implementation plan. A working group within the organization, consisting of employees, HR professionals, managers, and prevention workers will select and implement activities from the catalogue according to the criteria of the integrated approach. This way, both employers and employees are involved, and the integrated WHPP can be adapted to local needs and available resources.

Recruitment

This study was embedded in a larger study in which an integrated WHPP will be developed, implemented and evaluated (24). Organizations that will participate in the cluster randomized controlled trial (c-RCT) to evaluate the integrated WHPP were recruited trough the network of the research team, co-workers and branch specific networks and platforms. Organizations could participate in the c-RCT when they had not yet implemented an integrated WHPP (i.e. implemented activities on both the individual and organizational level within multiple lifestyle themes). Organizations were not systematically asked for their motivation to participate in the c-RCT. However, conversations with organizations revealed that it involved contributing to the health and sustainable employability of employees. Peer-interviewers and interviewees for the current qualitative study were recruited within two of the organizations that agreed to participate in the c-RCT. A cleaning company and two departments of a University of Applied Sciences, the ICT- and a facility-department. Peer-interviewers were recruited by (1) supervisors within the organization who informed employees about the study and asked them to participate as a peer-interviewer, or (2) a short presentation by one of the researchers (DS) on the aim and process of the peer-interviewing. Afterwards

employees could sign up as a peer-interviewer. All employees who spoke and understood Dutch were eligible to participate as a peer-interviewer, with the exception of employees in a management position. None of the peer-interviewers had prior interview experience. Peer-interviewers were asked to interview five co-workers from their department who differed in age, sex, and job function, to create a heterogenic study population.

Data collection

All peer-interviewers followed an online training of 2 hours, provided by the researchers. In the training, they were educated on how to conduct an interview with a co-worker, were informed about how to obtain informed consent from their co-workers, practiced their interview skills with other peer-interviewers and received feedback from the researchers. The interviews were semi-structured and included three main questions: (1) about what employees think about when it comes to lifestyle; (2) about the current offer of WHPPs by their employer and whether and why they would participate or not and; (3) about the way they would like to be informed about WHPPs within their organization. To assist the peer-interviewers, they received cards with interview instructions, information about the study, main questions, sub-questions per main question and tips for further follow-up questions. Furthermore, they were instructed to listen carefully to their co-workers and adapt and personalize the follow-up questions when deemed appropriate. Additionally, age, sex, working hours, years of working at the organization and job type were asked. The main and sub-questions are depicted in Table 1. One-on-one interviews were performed at the workplace and could be face-to-face or online. This depended on the work situation of the peer-interviewers, since working from home was part of the COVID-19 restrictions at the time of this study. Interviews were audio or online recorded.

Table 1. Main and sub-questions of the semi-structured interviews.

	Main questions	Sub-questions
1	When you think about lifestyle, what do you think about?	What would you like to improve, regarding your lifestyle?
		How could your employer help you to improve your lifestyle?
2	Does your employer organize activities to improve your lifestyle?	Did you participate in such an activity?
		Under what circumstances would you participate in such an activity?
		Under what circumstances would you not participate in such an activity?
3	How would you like to be informed about activities at work to improve your lifestyle?	

Theoretical framework for qualitative analysis

The Consolidated Framework for Implementation Research (CFIR) was used as framework for the thematic analysis, complemented with two constructs of a social ecological model (8, 31, 32). The CFIR is an overarching framework to guide implementation research in which multiple implementation frameworks are integrated (32). The CFIR was chosen for this study because of its comprehensiveness and fit in the implementation of WHPP (20, 33, 34). The framework consists of five domains: (1) intervention characteristics, (2) outer setting, (3) inner setting, (4) characteristics of individuals, and (5) process. 'Intervention characteristics' contains key attributes of the WHPP, 'outer setting' addresses the external environment whereas the 'inner setting' describes the situation within the organization. The domain 'characteristics of individuals' is associated with the actions and behaviors of the involved individuals, in this case, the employees. The domain 'process' involves implementation strategies. Constructs within these domains are expected to influence implementation. Hence, the CFIR can assist in identifying barriers and facilitators for implementation of a WHPP (32, 35).

The CFIR is originally applied from the implementers' perspective. Since the focus of this study is on the barriers and facilitators of participation according to employees, definitions of some constructs had to be adapted. The domain characteristics of individuals originally addressed the characteristics of implementers. In this study it addresses characteristics of employees, i.e. the users of the program. The outer setting of the CFIR also included the construct patient needs and resources, for the

purpose of this study we transferred this construct to the domain characteristics of individuals. Additionally, needs and resources of employees were included as two separate constructs. The construct peer pressure, from the domain outer setting, was adjusted to peer support in the inner setting. The definition of the construct leadership engagement was adapted, so it focused on the role of supervisors in motivating and stimulating employees to participate. The construct available resources originally focused on the level of resources made available for implementation. This was replaced within the construct organizational resources, which targets the facilities and time provided by the organization to enable participation in WHPPs for employees. The construct knowledge and beliefs about the intervention is split into two separate constructs, i.e. knowledge about and familiarity with the intervention and beliefs about the intervention. Furthermore, the domain characteristics of individuals was extended with two constructs, the 'interpersonal factors' and 'intrapersonal factors', of the social ecological model (8). Social ecological models are a useful tool to explain behavior of an individual, for instance participation in a WHPP (8).

Analysis

Interviews were transcribed verbatim and, after familiarization, analyzed by two researchers (DS, JC). Two steps of the analysis of qualitative data according to the CFIR were followed: (1) thematic coding and (2) rating. In the first step, the existing codebook of the CFIR with the additional constructs of the social ecological model was used to code the data (8, 32). A hybrid approach was applied, which allows for both inductive and deductive coding (36). Additional codes that emerged from the data were added to the codebook (inductive). In total, 21 constructs of the CFIR and two constructs of the social ecological model were used and seven constructs were added (Fig. 1). The MAXQDA 2020 software was used for the thematic coding process. In total, six interviews were double coded independently by the two researchers, afterwards the interviews were compared and discussed until consensus was reached. The remaining interviews were divided under the researchers, coded, and checked by the other researcher. Discrepancies were discussed until consensus was reached. A third researcher (SO) was consulted in case of disagreement. Due to the hybrid approach, the codebook was continuously enriched with new codes, prior coded interviews were recoded if necessary. In the second step, the constructs were rated to establish (1) the valence of a construct, i.e. the positive or negative influence of the construct on participation and (2) the strength of this influence. Constructs could also be rated to have a neutral or mixed influence on participation (Table 2). Ratings were assigned based on the qualitative data from individual transcripts (37). The rating criteria were slightly adapted from those reported by the

CFIR developers since the CFIR is not applied from the implementers' perspective in this study (38). Instead of impeding or facilitating factors for implementation, we assessed impeding or facilitating factors for participation. The coded segments were double rated independently by two researchers (DS, JC). Afterwards, ratings were compared and discussed until consensus was reached, in case of disagreement, a third researcher (SO) was consulted.

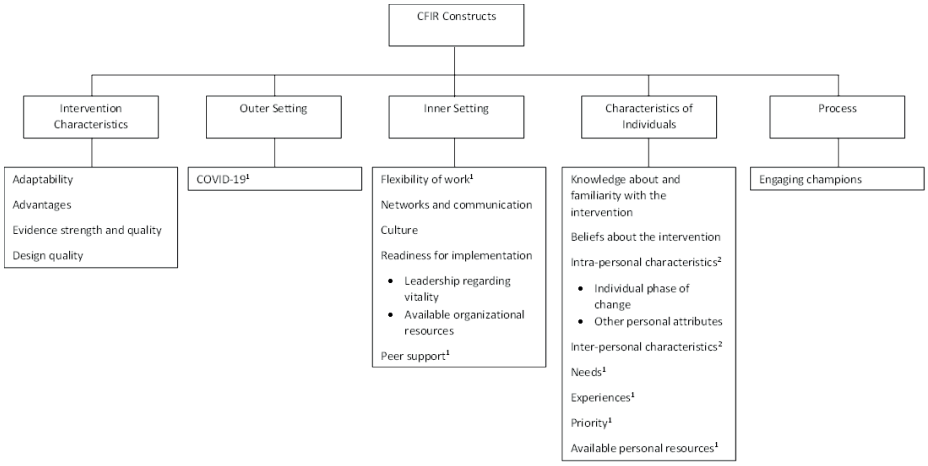

Figure 1. Overview of the constructs, mainly based on the CFIR.
[1] Added constructs
[2] Constructs from the social ecological model
The constructs with a neutral influence on participation in WHPPs are not included in this figure

Table 2. Rating criteria applied in the rating step.

-2	The construct is an impeding influence for participation in WHPPs by employees. The majority of employees describe explicit examples of how the construct manifests itself in a negative way
-1	The construct is an impeding influence for participation in WHPPs by employees. Employees make general statements about the construct manifesting in a negative way but without concrete examples
0	A construct has neutral influence if it appears to have a neutral effect, i.e. no obvious positive or negative influence
X	The construct can have a mixed rating if the comments are both positive and negative
+1	The construct is a facilitating influence for participation in WHPPs by employees. Employees make general statements about the construct manifesting in a positive way but without concrete examples
+2	The construct is a facilitating influence for participation in WHPPs by employees. The majority of employees describe explicit examples of how the key or all aspects of a construct manifests itself in a positive way

Results

Characteristics of the participants

Fourteen peer-interviewers were trained and conducted 1–6 interviews each. Three peer-interviewers worked for a cleaning company, seven worked at a facility department and four worked at an ICT department. In total, the peer-interviewers conducted 62 peer-to-peer interviews, which lasted between 3 and 25 min. Ten interviewed employees worked for a cleaning company, 34 worked at a facility department, and 18 worked at an ICT department. Characteristics of the 62 interviewed employees are further specified in Table 3.

Table 3. Characteristics of employees who participated in an interview (n = 62*).

	Total	Cleaning company	Facility department	ICT department
Age in years (mean, SD)	49.5 (9.5)	45.6 (8.3)	50.1 (10.0)	50.1 (8.4)
Sex (m/f)	31/31	1/9	16/18	14/4
Working hours per week by contract (mean, SD)	32.6 (8.0)	32.2 (10.5)	31.7 (8.2)	34.9 (4.4)
Years of working at the organization (mean, SD)	9.7 (7.5)	11.4 (3.0)	7.0 (6.6)	13.9 (8.2)
Summary of job types	N.A.	Cleaner, allround employee	Concierge, receptionist, campus store sales representative, security guard, process coordinator	Administrator IT, employee service desk, system administrator

*Descriptive data from eight employees were not complete

Barriers and facilitators

The findings are described based on the rating of the constructs. Details about the rating are displayed in Table 4.

Intervention characteristics

Within this domain the constructs 'advantages' (+ 2), 'evidence strength and quality' (+ 1), and 'adaptability' (+ 1) were facilitators for participation. Employees are more likely to participate in WHPPs when they are aware of the advantages of a program, in terms of health benefits including both physical- and social-health effects. Moreover, personal goals that can be achieved through participation in WHPPs are seen as advantages and might, therefore, facilitate participation. When there is evidence that a program can lead to increased health, employees indicate to be

more willing to participate. This can be achieved by informing employees about the potential of proven effects. Employees also indicate that they would be more inclined to participate when programs are adapted to their age, their daily working schedule, or when there is sufficient choice in locations or types of sports: "*Well you know what would help me, and I believe [the organization] also offers opportunities for that, is for example fitness. But then tailored to my body or my age, or to my goals*" (Facility department, male, age 49).

'Design quality' (x) can both facilitate and hinder participation. Employees mention that a high quality WHPP, i.e. an evidence- or practice-based WHPP, can positively influence participation. The experienced quality can be improved by involvement of professionals or students. A mandatory program is a barrier for participation according to employees, whereas a program free of charge will support participation.

Outer setting

The 'COVID-19 pandemic' (– 1) appeared to be a barrier for participation in WHPPs. Employees do not want to be at risk of becoming infected when they participate in a WHPP: "*Peer-interviewer: And under which circumstances would you no longer participate in such activities? Employee: Well, that answer is actually quite simple, because of COVID-19. Because were it not for COVID-19, I would just participate.*" (ICT Department, male, age 32).

Table 4. Rating of the constructs.

Construct	Rating
Intervention characteristics	
Adaptability	+1
Advantages	+2
Evidence strength and quality	+1
Design quality	X
Outer setting	
External policies	0
COVID-19	-1
Inner setting	
Flexibility of work	-2
Networks and communications	+1
Culture	-2
Tension for change	0
Compatibility	0
Relative priority	0
Goals and feedback	0
Leadership regarding vitality	+1
Available organizational resources	X
Peer support	+1
Characteristics of individuals	
Knowledge about and familiarity with the intervention	-2
Beliefs about the intervention	X
Self-efficacy	0
Individual phase of change	X
Other personal attributes	-1
Interpersonal characteristics	-1
Individual identification with the organization	0
Needs	-1
Experiences	+2
Priority	X
Available personal resources	-1
Process	
Stakeholders	0
Champions	+1

Inner setting

The constructs 'peer support' (+ 1), 'leadership regarding vitality' (+ 1) and 'networks and communication' (+ 1), were identified as facilitators in this domain. Peer support can trigger employees to participate in WHPPs, as it brings an additional social component and co-workers can motivate each other. On the other hand, a small group of employees feels no need to engage in lifestyle related activities with their co-workers. For example, because they prefer to exercise on their own. With regard to the construct leadership, employees shared that information about the importance and possibilities of WHPPs provided by supervisors or managers can support their participation. This is also the case for supervisors who actively motivate and support their employees to participate: "*And when your supervisor indicates that it [WHPP] is good for you. […] Then you might also literally get people moving who otherwise might not have signed up for something of their own accord*". (Facility department, female, age 25). Employees indicated that when communication about the WHP possibilities within the organization is clear and sufficient, there possibly is a lot of enthusiasm for it among their selves and co-workers: "*Peer-interviewer: When would you participate in such an activity though? Employee: If I were informed a little bit more. What the concrete possibilities are within [the organization]*". (Facility department, male, age 54). Additionally, employees mentioned they would like to be informed about WHPPs via presentations, information markets or other visible manners, posters, by phone, intranet, social media, newsletters, a personal approach and e-mail. However, an overload of information should be avoided, as this can lead to ambiguities or a lack of interest. Employees prefer active distribution of information, since it is not likely that they are going to look for information about WHPPs on their own initiative.

A lack of 'flexibility of work' (– 2) and an unsupportive 'organizational culture' (– 2) were identified as barriers within the inner setting domain. Employees who are not able- to leave their workplace during work time or have no flexibility to start or stop working later or sooner than scheduled, stated that it hampers their participation in WHPPs: "*I know that Tai Chi, yoga and office yoga, or the like, are organized during lunch breaks, and walks too, but it's just very difficult to leave this workplace. You can't leave the reception unoccupied. […] Or you would have to arrange replacements, but I think that is a bit difficult. Maybe I do not have enough of a nine to five mentality and feel too much responsible to leave my workplace for something like that*". (Facility department, female, age 49). Employees indicated that they would not participate in WHPPs when faced with an unsupportive organizational culture. For example when participation in WHPPs, especially during working hours, is not commonly accepted by co-workers: "*Peer-interviewer: Look, in the past there also have been*

activities that were organized so to say, during the day, do you experience any obstacles to participate in such activities because it is during working hours? Because that's where you end up, isn't it? Employee: Yes, that's true, […] that restraint is still there. […] it's not yet such a widely accepted, given". (Facility department, male, age 42). Additionally, in a culture where employees see their health and lifestyle as something private and not as something work-related, participation is hampered.

The construct 'available organizational resources' (x) had a mixed rating. The availability of a financial compensation,- for example for a gym or other sport will support participation. In contrast, high prices for healthy food in the company restaurant will hamper participation. According to employees, they are more likely to participate when the location of a WHPP is easy to reach. Hence, facilities such as a gym at the workplace are facilitators for participation with the lack of such facilities being a barrier. Another factor is time, the possibility to participate during working hours can be a facilitator, since a lack of time after working hours is a frequent barrier: "*Peer-interviewer: What could the employer really do to make you participate? […]. Employee: Maybe if you are allowed to participate during working hours? Then you are more inclined to participate. Besides that I wouldn't know*". (ICT department, male, age 47).

Characteristics of individuals

The construct 'experiences' (+ 2) was the only facilitator within the domain characteristics of individuals. Employees suggest that positive experiences with a WHPP, such as feeling healthier or having a good time, would be a reason to participate in other WHPPs as well. 'Knowledge about and familiarity with the intervention' (– 2), 'other personal attributes' (– 1), 'personal resources' (– 1), 'interpersonal characteristics' (– 1), and 'needs' (– 1) were identified as barriers in this domain. With regard to knowledge and familiarity, it was emphasized that if employees were not aware of a program or when programs are unclear, they would not participate: "*Look, if you don't know about the existence of WHP activities, then you're not going to use them either*". (ICT Department, male, age 38). Personal attributes such as injuries or a lack of energy, and a lack of personal resources such as time and financial resources also hinder participation. Family and friends, e.g. interpersonal characteristics, can motivate employees. However, the time and energy that is spent on a busy household hamper participation in WHPPs outside working hours. Also, employees indicate that they prioritize time spent with family over participation in WHPPs. Employees mention that they will not participate when a program does not fit their needs or when they do not enjoy it: "*[…] When I wouldn't participate in a challenge or something, if it isn't really in my field of interests, yes that*

would be my answer. Actually it's very simple". (ICT department, male, age unknown). Employees who are already engaged in a healthy lifestyle, employees who do not recognize that their current lifestyle should be improved and employees who see their work as physical exercise, do not feel any need for participation in WHPPs: "*Peer-interviewer: What would make you participate in such an activity? Employee: When it involves sports and exercise, I would not participate, because I get enough of those already. I mean through cleaning*" (Cleaning company, female, age 26).

The constructs 'beliefs about the intervention', 'priority' and 'individual phase of change' had a mixed rating (x) within this domain. Employees who believe that improving lifestyle is something you have to do yourself, and not something that your employer should facilitate, are less inclined to participate in WHPPs: "*Peer-interviewer: How can your employer help you to improve your lifestyle? Employee: Well I don't think that he [employer] can improve it [my lifestyle] that much, because it's something that I have to do myself*". (Cleaning company, female, age 50). The same goes for employees who indicate that they do not know how their employer could facilitate a healthy lifestyle of employees. On the other hand, employees with a positive attitude towards and belief in WHPPs, are more open to participation. When employees see the benefits and necessity of a WHPP, the construct priority is a facilitator. On the contrary, if employees are already actively engaged in a healthy lifestyle in their private time, their priority will not be to participate in WHPPs. Besides, most employees said to prioritize their work over lifestyle at the workplace, making priority a barrier as well. When employees are aware of the importance of a healthy lifestyle, it is more likely that they will participate. In contrast, if an employee is not aware of the importance of a healthy lifestyle, or when they do not recognize that there is a problem with their lifestyle, their individual phase of change hampers participation in WHPPs.

Process

The engagement of 'champions' (+ 1) was mentioned as a facilitator for participation. Enthusiastic employees might convince co-workers to participate and they can serve as a role model.

Discussion

Main findings

From the perspective of employees, positive experiences and knowledge about advantages of participation were important facilitators for participation. The most important barriers for participation in WHPPs were an unsupportive organizational culture, a lack of knowledge about WHPPs and various individual characteristics, such as a lack of personal resources. Organizational resources could act as both a facilitator and a barrier for participation.

Comparison with literature

Multiple other studies that identified barriers and/or facilitators according to employees were found with some similar findings (11, 12, 17, 39, 40). A perceived healthy lifestyle was a frequently mentioned barrier (11, 12), a barrier that also came forward in our study. This might imply that employees are indeed already engaged in a healthy lifestyle or that they do not recognize that their lifestyle needs improvement. Misperceptions about health and lifestyle are a known barrier for adapting lifestyle behaviors in general, possibly due to a lack of knowledge or awareness (19). For instance, there often is a lack of knowledge about the different health effects of exercising in leisure time and occupational physical activity (OPA) (41). Literature shows that OPA can negatively affect health, whereas exercising in leisure time can benefit health (41). We found that employees with physically demanding jobs indicate that they do not need to exercise, because of the high OPA. This finding might imply a lack of knowledge about lifestyle and health, specifically for physical activity. Or it might suggest that employees with physically demanding jobs experience a lack of energy due to high OPA, which can be a barrier for participation in physical activity in leisure time. Other reasons for non-participation, in line with our findings, were not knowing about a WHPP, a preference to keep work and private life separate, inconvenient locations and a lack of time (11, 12, 17, 39, 40). A strategy to overcome the latter barrier might be participation in WHPPs during working hours. Nevertheless, our results indicate that when there is a lack of flexibility of work, e.g. not able to leave the workplace, a WHPP during working hours is a barrier. This emphasizes the importance of taking into account the resources, including private time and working schedules, of employees when implementing a WHPP. Various characteristics of individuals were identified as a barrier for participation in WHPPs in our study. These constructs might also be affected by organizational factors. For instance, a lack of energy and time might be explained by high (physical or mental) job demands or a lack of flexibility of work. Prioritizing family and friends over WHPPs has to do with work-

life balance, which in turn might be related to the perceived workload as well. From other research it was observed that facilitators were social support from supervisors and co-workers and a positive attitude (12, 39). These findings were in line with our data. Additionally, we found that a negative attitude or no belief in WHP hampered participation. According to Rongen et al., other factors that play an important role in whether an employee decides to participate or not are the preferences of an employee and the organizational environment (12). These findings are supported by our findings and other literature (17, 39, 40).

Strengths and limitations

The main strength of this study is the active participation of employees in collecting information about barriers and facilitators from their perspective. The peer-to-peer interview method is an innovative participatory approach (23). Advantages of the peer-to-peer interviews are enhanced research capacity and a positive change in behavior towards the study topic (18, 22). Further, interviewees are expected to answer more genuinely to their peers since a shared language and experiences make it easier to connect and create common ground and trust (30, 42-44). On the other hand, despite the use of semi-structured interview cards, interviews cannot be redirected when they go off topic and in case of ambiguities the researcher cannot ask for clarification afterwards (42, 43). However, this only occurred occasionally in this study. Moreover, none of the peer-interviewers had prior experiences in interviewing. To support the peer-interviewers as much as possible, a training for the peer-interviewers was provided, in which they practiced and received feedback on their interview skills. Nevertheless, closed questions were asked in a few interviews. For instance, the duration of one of the interviews was only three minutes. Hence, in future studies with peer-to-peer interviews extra guidance and support could be useful. For example, feedback can be provided after the first interviews, a helpdesk for questions can be set, or a researcher can be present during the first interviews. It should be considered that relevant information might be missed due to the lack of experience of the peer-interviewers. However, we expect this limitation to be partially mitigated by the high number of interviews that was carried out. Each peer-interviewer will focus on other topics, which overall is expected to lead to fairly complete information. Moreover, Devotta et al. argued that peer-interviews could even lead to richer qualitative data, due to a stronger connection between interviewer and interviewee (30).

Due to the COVID-19 restrictions at the time of the study both the training and part of the interviews were online, which can be viewed as a limitation of our study. However, feedback about the online training from the peer-interviewers was

positive and if there were any questions afterwards, they could easily reach the researchers. Some peer-interviewers used this opportunity. In online interviewing it might be more difficult to connect when body language is limited and poor network connections can interrupt the interviews (45). However, advantages and positive reactions on online interviewing have been reported, which indicates that online interviewing is an appropriate option to yield qualitative data (45, 46). Reported advantages of online interviewing are accessibility and flexibility and participants are interviewed in their own chosen space. Despite the distance, there still is a more personal connection with the interviewer when compared to interviews over the phone.

Another strength of this study was the use of the CFIR, this framework can be used across various contexts, including implementation of WHPPs (47). Furthermore, it is designed to identify barriers and facilitators during the pre-implementation phase (32, 35). Since this is a study from the user perspective instead of the implementers' perspective, we made small adaptations and added two constructs from the social ecological model. The framework suited the data and the purpose of this study, as only few additional codes emerged and no additional domains were necessary. Final strengths were the total number of interviews and the heterogenic group of employees that participated in this study. Various job types were represented, therefore, results can also be representative for other organizations.

Possible selection bias should be taken into account as all organizations recognize the importance of WHP. Moreover, employees that applied as peer-interviewers might be the employees who also consider WHP to be of importance. However, not all interviewees had the same idea about the importance of WHP. This might indicate that there is less selection bias on the level of interviewees. The fact that organizations were recruited through the network of the research team is not expected to influence the results of the peer-to-peer interviews, as the peer-interviewers and interviewees were not involved in the decision of the organization to participate in this study.

Implications

To increase participation in future WHPPs it is important that employees have a positive attitude towards WHP, are aware of the WHP offer at the workplace and know what a healthy lifestyle entails. To achieve this, clear and active communication, tailored to the target group, about possibilities and the importance of WHP, is key (21, 39, 40, 48). Hence, it is crucial that organizations actively inform their employees using a variety of communication channels, such

as a personal approach, distribution of information by supervisors, e-mails and posters. Additionally, the facilitator social support should be deployed to positively affect the organizational environment. Thus, support from supervisors should be encouraged and enthusiastic employees should be appointed as ambassadors, to act as a role model for participation in WHPPs (14, 17, 39). Moreover, it is paramount for employers to be aware of the available resources and needs of employees. For this reason, employers should involve employees during the development and implementation of WHPPs (11, 17, 21, 39). To intervene on barriers on the individual level, employers should critically review, and if necessary adjust, organizational factors, such as the perceived job demands of employees. Future research should assess whether considering these barriers and facilitators prior to implementation leads to an increase in participation.

Conclusion

In conclusion, a supportive organizational culture and a positive individual attitude and knowledge seem necessary to increase participation of employees in WHPPs. This study showed that both individual factors and organizational factors play an important role in the participation of employees. Strategies to overcome barriers for participation will be incorporated in an implementation plan, to better implement the integrated WHPP. The effectiveness of the integrated approach, consisting of the catalogue and implementation plan, will be evaluated in a cluster randomized controlled trial. A process evaluation will provide more insight in the success of the implementation of the integrated WHPP. We recommend stakeholders, such as employers and occupational health and safety professionals, involved in the implementation of integrated WHPPs, to use this knowledge about barriers and facilitators for the implementation of future WHPPs.

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4

Chapter 4

Barriers and facilitators to the implementation of workplace health promotion programs: Employers' perceptions

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Abstract

Background: Workplace health promotion programs (WHPPs) can benefit the lifestyle and health of employees. However, not all WHPPs have been successful in their implementation, and thus their effectiveness. This study aimed to identify the barriers and facilitators to implementing an integrated WHPP, which targets multiple lifestyle factors at different levels (individual and organizational), from an employer's perspective.

Methods: Data were collected by two online focus groups among 18 representatives of eight different organizations. Data from the focus group discussions were transcribed verbatim and analyzed using thematic analysis. Data were coded both inductively and deductively, using the Consolidated Framework for Implementation Research (CFIR) consisting of the following five domains: (1) intervention characteristics, (2) outer setting, (3) inner setting, (4) characteristics of individuals, and (5) process. Ratings were performed to indicate the positive or negative influence and strength of a construct regarding the implementation of WHPPs.

Results: Barriers and facilitators in all domains of the CFIR were found. Regarding characteristics of the WHPP, complexity and costs hindered implementation, while high adaptability facilitated it. An organization that met the needs of employees (the outer setting) facilitated implementation. Available resources, access to knowledge, leadership involvement, and continuity of communication were facilitators within the inner setting. Barriers were different approaches to implementation within one organization and the perceived interference with employees' lives. For the implementation process, the involvement of key stakeholders, including employees, was identified as an important facilitator.

Conclusion: Various barriers and facilitators in different domains play a role in the implementation of integrated WHPPs, according to employers. Strategies that tackle the identified barriers and incorporate the facilitators will likely contribute to the successful implementation of integrated WHPPs.

Keywords: Workplace health promotion programs, Employers' perspectives, Implementation, Consolidated framework for implementation research, Qualitative study, Integrated approach

Introduction

The workplace is described as a promising environment to encourage people to make healthier lifestyle choices (1, 2). Workplace health promotion programs (WHPPs) aim to improve lifestyle and consequently health- and work-related outcomes (3). The effectiveness of these programs has been investigated in numerous studies (4, 5). For example, Verweij et al. (4) found significant effects on the reduction of body weight, BMI, and body fat. Moreover, increased productivity rates, decreased absenteeism, and therefore a reduction in associated costs are potential benefits for employers (6).

Despite proven positive effects, not all WHPPs that have been implemented over the years have been successful (7). The difficulty of the translation from research to practice has been acknowledged (8). Health promotion interventions that are based on proper underlying theory may not yield positive effects in practice as a consequence of poor implementation (8). For example, inadequate implementation strategies may contribute to poor compliance and low participation rates of employees and hence a lack of effectiveness (9). Participation rates in WHPPs differ across studies from 8 to 97% but are on average low, with participation levels below 50% (10, 11). To maximize participation levels and thereby increase the success rate of a WHPP, the implementation process should be carefully considered, as was emphasized in earlier research (9, 11, 12). To date, no firm conclusions about strategies to improve the implementation of WHPPs can be drawn, as implementation research on WHPPs is "only just emerging" and more research is warranted (13).

To achieve successful implementation, a needs assessment, including an assessment of barriers and facilitators regarding the implementation of a WHPP, is needed (5). As employers are key stakeholders in this, it is critical to consider their perspective on the factors that impede or facilitate implementation (5, 14). This study was conducted in preparation for the development, implementation, and evaluation of an integrated WHPP in which a European good practice, the "Lombardy Workplace Health Promotion (WHP) Network," was tailored to the Dutch context (15). The success factor of the Lombardy program was the integrated approach to promote multiple healthy behaviors at both the individual and organizational levels (16). This study aimed to identify barriers and facilitators to the implementation of a Dutch-integrated WHPP by assessing the experiences of employers with implementing WHPPs.

Material and methods

Study design

A qualitative design consisting of focus groups with representatives of employers was used. In focus groups, interaction and discussion between group members are stimulated, which leads to extra information and collective views on a topic (17).

Study population

The study population consisted of 18 employers or representatives from eight Dutch organizations who had experience in implementing a WHPP. Job positions included director, human resources (HR) officer, and manager. All organizations had more than 250 employees. Based on the International Standard Industrial Classification of All Economic Activities (ISIC) (18), the participating employers were from different sectors, as presented in Table 1. In total, 10 employers participated in the first focus group and eight employers in the second. Organizations were recruited via the networks of the project team members, co-workers, and branch-specific networks and platforms. At first, announcements to participate in an intervention study in which an integrated WHPP would be implemented were distributed through online platforms. A total of 13 organizations were interested and responded by e-mail; out of those, nine organizations were approached for this study, and eight of them decided to participate. For the recruitment of organizations, purposive sampling was used to pursue different organizations with blue-collar and/or white-collar employees (19). Additionally, representatives from the organizations were recruited to participate in the focus group through snowball sampling within the organization (19). An e-mail with practical information was sent to the organizations that participated in the focus groups.

Data collection

A semi-structured interview guide was developed and aimed to identify the barriers and facilitators to the implementation of WHPPs based on employers' experiences. The topics in the interview guide included (1) determinants that facilitated the implementation and (2) determinants that hindered the implementation of a WHPP. Questions such as "What factors caused the implementation to be effective?" were asked. Because of the COVID-19 pandemic restrictions, the focus groups were conducted online using "GoToMeeting" and "Microsoft Teams." Both focus groups had a duration of 90min and were recorded with the permission of the respondents. Oral consent was obtained from all participants. The focus groups were conducted by one facilitator (DS). Two assistants took notes and managed time (JC and SO). To facilitate the active participation of all employers, they were asked to write down

barriers and facilitators to implementation individually during the focus group. Every participant then reported one factor, which was noted down using an online whiteboard. These factors were then discussed, and missing factors were added.

The theoretical framework for qualitative analysis

The Consolidated Framework for Implementation Research (CFIR) was used to identify the relevant factors for the implementation of a WHPP in the pre-implementation phase (21). The CFIR is composed of the following five domains: (1) intervention characteristics, (2) outer setting, (3) inner setting, (4) characteristics of individuals, and (5) process. "Intervention characteristics" involved the features of the WHPP itself, the "outer setting" of the external environment (22). "Inner setting" concerned features of the implementing organization (22). The fourth domain was used to explore "individual characteristics" of the implementers that might influence implementation, and "process" contained the strategies involved in the implementation (22).

Table 1. Characteristics of participants (*n* = 18).

Industry	**NO. (%)**
Administrative and support service activities	2 (11.1%)
Electricity, gas, steam and air conditioning supply	2 (11.1%)
Accommodation and foodservice activities	3 (16.7%)
Public administration and defense; compulsory social security	3 (16.7%)
Manufacturing	3 (16.7%)
Education	5 (27.8%)
Job title	
Advisor	3 (16.7%)
Director	1 (5.6%)
HR officer	2 (11.1%)
Manager	9 (50%)
Policy officer	2 (11.1%)
Prevention officer	1 (5.6%)

Table 2. Criteria used to assign ratings to the constructs, based on the CFIR framework (20).

-2	The construct is a negative influence in the organization, an impeding influence in work processes, and/or an impeding influence in implementation efforts. The majority of employers describe explicit examples of how the key or all aspects (or the absence) of a construct manifests itself in a negative way
-1	The construct is a negative influence in the organization, an impeding influence in work processes, and/or an impeding influence in implementation efforts. Employers make general statements about the construct manifesting in a negative way but without concrete examples: - The construct is mentioned only in passing or at a high level without examples or evidence of actual, concrete descriptions of how that construct manifests - There is a mixed effect of different aspects of the construct but with a general overall negative effect - There is sufficient information to make an indirect inference about the generally negative influence; and/or - Judged as weakly negative by the absence of the construct
X	The construct can have a mixed rating if: - The comments are equally positive and negative
+1	The construct is a positive influence in the organization, a facilitating influence in work processes, and/or a facilitating influence in implementation efforts. Employers make general statements about the construct manifesting in a positive way but without concrete examples: - The construct is mentioned only in passing or at a high level without examples or evidence of actual, concrete descriptions of how that construct manifests - There is a mixed effect of different aspects of the construct but with a general overall positive effect; and/or - There is sufficient information to make an indirect inference about the generally positive influence
+2	The construct is a positive influence in the organization, a facilitating influence in work processes, and/or a facilitating influence in implementation efforts. The majority of employers describe explicit examples of how the key or all aspects of a construct manifests itself in a positive way

Data analysis

The data from the focus group discussions were transcribed verbatim and analyzed with MAXQDA 2020. A thematic analysis was used, as described by Braun and Clarke (23). Moreover, a hybrid process of deductive and inductive coding was used for the analysis (24). The data were analyzed by two researchers (JC and DS) separately, then compared and discussed, and in case of disagreement, discussed with a third researcher (SO) to reach a consensus. The first step was to familiarize ourselves with the data by reading the transcripts of the focus groups. In step two, an initial codebook was formed deductively based on the CFIR's five domains and constructs. The combination with the inductive approach offered the possibility of including new codes that emerged from the data (24). The third step was the organization of themes and codes, wherein sections of the data that represented the same code were gathered. In the fourth step, all themes and codes were reviewed and reconsidered. In the fifth step, the themes were further refined, and the essence of each theme and construct was clarified. Finally, the CFIR's constructs were ranked

independently by two researchers (JC and DS) (20). The ratings reflect the valence, implying whether the construct hampered or facilitated implementation, and the strength, ranging from −2 to +2 (20). The rating criteria used for this study are shown in Table 2. The data analysis was an iterative process, as the first focus group was analyzed before the second focus group was conducted (25).

Results

In total, barriers and facilitators were identified in 25 constructs (Fig. 1). The ratings of the constructs are presented in Table 3.

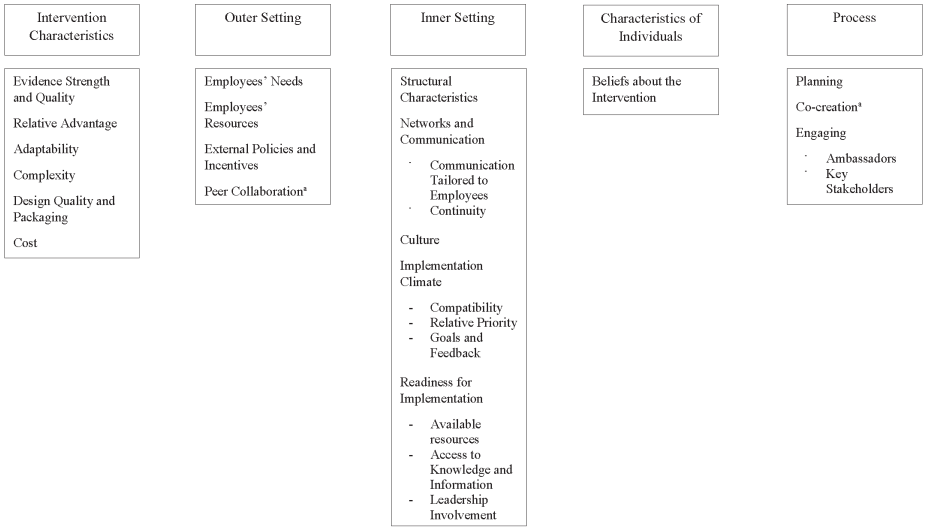

Figure 1. Overview of the constructs in which barriers and facilitators were identified, categorized according to the five domains of the CFIR.

[a]Emerged inductively as a construct.

Intervention characteristics

Facilitators

Constructs related to the characteristics of the program that had a strong positive influence (+2) on implementation according to multiple employers were **Evidence Strength and Quality** and **Adaptability**. Employers preferred a WHPP that was evidence-based, as they believed this increased the chance of successful

implementation. Moreover, evidence of the usefulness of the WHPP was helpful in engaging other stakeholders:

> *"We are responsible for convincing people about the usefulness of the program. A program must have a guide for the promotion and a description of the usefulness and necessity, as this helps people to sell it [the program] in the organization."—[Manufacturing, manager]*

It was indicated that it should be possible that a program can be adapted to meet the needs of the target group, in this case, employees. Examples of the adaptability of a WHPP included programs that were suitable to the employees' life stages. For instance, a program that incorporates themes based upon the employee's life stage, such as work-life balance for younger employees and sustainable employability for older employees, has high adaptability and therefore meets the local needs of the employees. Other WHPPs that were adaptive and thus facilitated implementation included WHPPs that were intertwined with the employee's job, e.g., by adapting the content to the nature of their work.

The constructs **Relative Advantage** and **Design Quality and Packaging** were assigned +1. It was indicated that if the impact of WHPPs within the organization was assessed beforehand, this was helpful in prioritizing which WHPPs to implement. To improve the design and quality of the WHPP, it was mentioned that the use and integration of professionals' knowledge into the design served as a facilitator:

> *"We have used the knowledge of physiotherapists and physical therapy students in our project to give substance to our intervention. We know several things, but these professionals can convey it in a better way, in a clearer way, and they will also be received differently [. . .] by the employees."—[Administrative and support service activities, policy officer]*

Employers found the enrollment of employees to be both a facilitator and a barrier. It was seen as a facilitator if the enrollment was made accessible and easily done, for instance by automatic enrollment in the WHPP instead of employees having to sign up themselves. Enrollment through the supervisor or other individuals in leadership roles was experienced as a threshold for employees. Furthermore, there were different opinions regarding the obligatory nature of WHPPs. One employer emphasized the importance of voluntariness, as not all employees are into lifestyle changes or do not realize they need to improve them, while the latter was a reason for another employer to make WHPPs obligatory.

Table 3. Barriers and facilitators to the implementation of a WHPP.

Domain	Construct	Rating
Intervention characteristics	Evidence Strength and Quality	+2
	Relative Advantage	+1
	Adaptability	+2
	Complexity	-2
	Design Quality and Packaging	+1
	Cost	-1
Outer setting	Employees' Needs	+1
	Employees' Resources	X
	External Policies and Incentives	+1
	Peer Collaboration[a]	+1
Inner setting	Structural Characteristics	-2
	Networks and Communications	
	- Communication tailored to employees	X
	- Continuity	+2
	Culture	-2
	Implementation Climate	
	- Compatibility	+1
	- Relative Priority	+2
	- Goals and Feedback	X
	Readiness for Implementation	
	- Available Resources	+2
	- Access to Knowledge and Information	+2
	- Leadership Involvement	+2
Characteristics of individuals	Beliefs about the Intervention	-1
Process	Planning	+2
	Co-creation[a]	+2
	Engaging	
	- Ambassadors	+1
	- Key stakeholders	+1

[a]Emerged inductively as a construct

Barriers

The constructs that negatively influenced the implementation were **Complexity** (−2) and **Cost** (−1).

The majority of employers expressed the complexity of a WHPP to be implemented as a barrier. WHPPs that had simple, practical approaches to implementation were considered facilitating:

> *"Success factors that I have experienced are sufficient and continuous attention for guidance and coaching and for the supervisors especially a concise and practical approach."— [Education, manager]*

One employer mentioned costs related to the implementation of the WHPP as a barrier.

Outer setting

Facilitators

The constructs **Employees' Needs, External Policies and Incentives**, and **Peer Collaboration** had an overall positive influence on implementation and were ranked +1. The construct employees' needs concerned the extent to which employees' needs are accurately known and met by the organization (22). Employers acknowledged that WHPPs that meet the needs of the target group, serve as a facilitator. An example was:

> *"Once, the organization came up with the idea of making a healthy canteen overnight. [...] Consequently, all employees went to the local snack bar. This was not very effective, and eventually, the menu was adjusted, so the meatballs returned. […] So, the target group really must want it. [...]"— [Accommodation and foodservice activities, HR officer]*

As for external policies, an employer stated that it was easy to impose a government policy regarding smoking cessation on employees. Another employer mentioned using a legal obligation in WHPPs as a facilitator. Furthermore, peer collaboration referred to the created learning situation when other organizations have already implemented WHPPs and exchanged their experiences to help other organizations implement WHPPs.

Mixed constructs

Employees' Resources (X) were addressed as a barrier and facilitator. The provision of an activity outside the organization was mentioned as a threshold to attend the activity. Moreover, a lack of time for employees and extra costs to be paid by employees were barriers, e.g., if healthy food offered in the canteen was more expensive than unhealthy food. On the contrary, when the organization prioritized the employees' resources and thus provided healthy foods for a reduced price, a favorable behavior change was seen.

Inner setting

Facilitators

Readiness for implementation involved **Available Resources**, **Access to Knowledge and Information**, and **Leadership Involvement**. These were all reported as important facilitators (+2). Multiple available resources, such as the need to provide WHPPs during working time, locations specifically designated for the WHPP, and a budget, were facilitators. Moreover, a success factor was to inform and educate supervisors separately on how to promote a healthy lifestyle for their employees. Examples given were a training or implementation guide for supervisors to support them in the implementation:

> *"It would be nice, if there was a manual or something for supervisors, with information about how you make these kinds of topics discussable. […] About how you stimulate employees to take that break or adopt a healthier lifestyle. These are often difficult things to discuss because it is often what you interfere with. So, I notice that supervisors need help with that."—[Education, policy officer]*

Leadership involvement, the involvement of leaders and managers with the implementation, was found to be an important aspect in the implementation of WHPPs:

> *[…] I think that supervisors are very important. What we notice is that people give up quickly when they're busy. They say: 'well, I don't have time for this.' But if a supervisor encourages them […], people are more inclined to do it."—[Public administration and defense; compulsory social security, manager]*

Additionally, supervisors who were actively engaged in the project and supported the employees during the participation in WHPPs facilitated participation. **Continuity**, part of the construct Networks and Communications, emerged as a strong facilitator (+2). The power of repetition was mentioned by multiple employers. Involvement and motivation rose when information was provided continuously:

> *"And so that it's also a permanent theme for them, permanently under the attention. You must repeat things more structurally or be present in a structured way to bring that theme to their attention continuously."— [Administrative and support service activities, policy officer]*

Compatibility (+1) and **Relative Priority** (+2), both part of the construct Implementation Climate, were ranked as facilitators. One employer mentioned that a WHPP that was compatible with and fitted with existing workflows and policies was considered a facilitator. Priority given by stakeholders, such as top management, facilitated getting the implementation of WHPPs on the agenda.

Barriers

Structural Characteristics and **Culture** were identified as barriers (−2) to the implementation, according to the majority of employers. Scattered health promotion initiatives were mentioned as a barrier, as this caused uncertainty for employees about what was offered. Different approaches within the company hindered the implementation of a WHPP throughout the whole company:

> *"A barrier is too many different policies. We have six clusters within [organization]. […] One has a vitality coordinator, the other has its working group, and it's quite difficult to find our way, as an organizational-wide program. So, I'm not sure if that's because of different policies, but it's maybe due to a lot of different approaches."— [Public administration and defense; compulsory social security, manager]*

Culture referred to the perceived interference with the employees' private lives, as was expressed by an employer:

> *"I think because that is seen as very patronizing as if you are interfering. I think that responsibility should also lie with the employees themselves. It will only work if an employee feels like it is important and is willing to work on it, because had I asked, 'What do you do about your health?',*

then he [employee] says: 'You know, I work from 9 to 5, you can interfere with that, but outside of that you can't'."— [Education, manager]

Mixed constructs

The constructs **Communication Tailored to Employees**, part of Networks and Communications, and **Goals and Feedback** were experienced to both hinder and facilitate implementation (X).

It was mentioned that communication should be tailored to the characteristics of the target group, the employees. A barrier was the use of a single communication channel, whereas the use of multiple communication channels was considered a facilitator. Delivering information to employees came forward as a difficult aspect:

"[...] My biggest frustration is that no matter what I do, I can't get it between the ears of the employees. With whatever campaign I'm running."— [Education, prevention officer]

To inform implementers of the program about the goals of the WHPP and to provide clarity regarding the expectations of a WHPP were facilitators. According to employers, goals were not always communicated clearly to implementers that was considered a barrier:

"It is very important to transfer the information and its purpose very clearly from within our organization to the intermediary, who eventually has to transfer it to the target group. Because if something is missing or not indicated in a structured way or insufficiently, tight and clear, then it also does not come across well to the target group. We noticed that in our interventions, and then you still have to intervene as an organization."— [Administrative and support service, policy officer]

Characteristics of individuals

Barriers

As to the construct **Beliefs about the Intervention** (–1), it was identified that a negative attitude of the supervisor toward WHPPs might hamper implementation even more than a positive attitude facilitating the implementation:

"Here it's really on the supervisor and I think that this works even stronger than the positive side. So, if the supervisor has a negative attitude, it is

> *difficult for the employees to ignore that and still go or work on it. [...] And if a supervisor has a positive attitude it's okay, also if the supervisor is neutral, but negative is a disaster."— [Electricity, gas, steam and air conditioning supply, manager]*

One employer added that it worked adversely when supervisors do not feel the need for the program and felt like they got extra work. In contrast, those supervisors that are advocates of a WHPP and believe in the potential of a WHPPs could just improve employees' work functioning.

Process

Facilitators

Planning and **Co-creation** strongly and positively influenced (+2) implementation. **Engaging Key Stakeholders** and **Engaging Ambassadors** had an overall positive influence on the implementation (+1). As to the planning, it is important to be clear about the time path of the implementation and to start early with the involvement of stakeholders within the organization. The facilitating effect of a quick implementation after the development process was expressed:

> *"Collecting information and turning it into action, we did that relatively quick. So, for the first six months, we collected information, and then for the second six months, we implemented it. We noticed that you should not wait too long with that. The implementation should follow quickly."— [Administrative and support service activities, policy officer]*

Co-creation referred to the involvement of employees in the development and implementation of a WHPP so that the program better fits the needs of the target group. More specifically, ambassadors (enthusiastic employees) were mentioned to be involved. Co-creation facilitated implementation in all cases and was used by multiple employers:

> *"We have collected and used input from the employees. Instead of imposing something top-down and thinking of it at a strategic level and then imposing it at an operational level. That often doesn't work or creates bottlenecks."— [Administrative and support service activities, policy officer]*

For an integrated WHPP especially, it was mentioned that it was important to involve key stakeholders. The following quote illustrates a lack of engagement of key stakeholders when there was little communication between the different departments:

> *"We had it all set up, but at the factory, their line supervisor didn't give them the time off to participate in a workshop. [. . .]. They also wanted to, but we forgot to coordinate with the factory itself that we would provide a workshop and time and space should be created for this, which is unnecessary for office workers for example."— [Manufacturing, HR officer]*

Discussion

Main findings

In our study, the CFIR was used to identify barriers and facilitators to implementing an integrated WHPP. WHPPs that are evidence-based and have the potential to be tailored to the target group were facilitators, while complexity and costs were barriers. Within the organization, it appeared important to have available resources, access to knowledge and guidance, and leadership involvement. Barriers were different approaches to implementation and the perceived interference with employees' lives. As to the implementation process, having structured planning and co-creation facilitated implementation.

Comparison with literature

In line with our study, other studies that identified barriers and/or facilitators according to employers reported some similar findings (7, 26, 27). A lack of management support was a frequently mentioned barrier and a facilitator when support was present (7, 26, 27). The importance of supervisors' attitudes toward WHPPs and their involvement in their implementation also came up in our study. Furthermore, employers identified that a negative attitude can have a greater impact on implementation than a positive attitude as was confirmed in our study. A lack of knowledge about the importance of health promotion or seeing it as an extra workload can cause a supervisor's negative attitude toward the implementation of a WHPP (28). Therefore, programs that aim to improve knowledge and attitudes among supervisors regarding health promotion can benefit the implementation of WHPPs (29). These programs can provide guidance on how to organize WHPPs, for example, which was identified as a need in our study and the study of Ruiz-Dominguez et al. (30). While leadership involvement appeared facilitating, employers in our study mentioned that employees could

perceive interference with their lives. Pescud et al. (31) mentioned that employers often do not feel the responsibility to improve their employees' health because they believe that employees should be responsible for their health. In our study, this was not identified, which could be a consequence of the fact that employers included were experienced with the implementation of WHPPs and thus had an affinity for health promotion among their employees. Another facilitator identified for implementation, in line with our study, is good collaboration with all stakeholders involved (7). It is recommended to engage managers and employees (co-creation) early in the planning process to develop strategies to overcome implementation barriers (26, 30). Moreover, since employers reported that different approaches or policies regarding health promotion were a barrier to implementation, it can be concluded from our study that it is important to have a good overview of who is working on what within the organization regarding health promotion. "Employee" or "healthy workplace" committees have been proposed to enhance engagement. Different stakeholders can be represented, including employees from various departments in an organization, "ambassadors" who enthusiastically support WHPPs, and management (26, 27). Such committees can improve employee participation as their needs are known and met by the organization. Also, employees' resources should be considered in these committees, since these were not met in our study and led to implementation challenges. Additionally, committees can improve management support as managers are kept informed about the progress of the WHPP and show that they are committed to the success of the WHPP (26, 27). Barriers and facilitators to the implementation of WHPPs, in line with our findings, were related to the organization's readiness and the availability of resources, respectively (7, 26, 27). Having a budget available was mentioned as a facilitator, which is in line with previous studies underlining the importance of resources at the organizational level, e.g. time, budget, and human resources (32, 33). In this study, costs were only mentioned by one participant as a barrier to implementation. Costs might be more of an issue in the decision-making about implementing WHPPs by the management of organizations. This might explain why costs are not often perceived as a barrier during the implementation phase. The extent to which resources are a challenge for the implementation of WHPPs depends on the type and size of the organization. Smaller organizations with fewer employees are less likely and less able than large organizations to offer WHPPs (34). However, WHPPs vary in terms of content and implementation costs. Smaller organizations can decide to start small with the implementation and scale up eventually (35).

Strengths and limitations

The main strength of this study is the identification of barriers and facilitators in the pre-implementation phase of an integrated WHPP by considering perceptions from employers about previously implemented WHPPs. In doing so, employers from different organizations with blue-collar and/or white-collar employees participated and represented a range of perspectives. Although representatives of employers were recruited based on previous experiences with the implementation of WHPPs to provide insights into barriers and facilitators, selection bias can be present as all participants feel the importance of health promotion in the workplace (36). Additionally, the organizations in this study had more than 250 employees, underrepresenting employers from small- and medium-sized enterprises (SMEs). Since SMEs have specific characteristics, such as time and resource constraints, other barriers and facilitators may play a role in the implementation of WHPPs in SMEs (37).

Due to the COVID-19 pandemic, both focus groups were online. The advantages of virtual focus groups are the relatively lower costs and the fact that participants can join in from their homes and do not need to travel (38). However, the interaction between participants might be different in online discussions. There may be either an increase in interaction due to the participants' feeling of anonymity or a decrease because of a potential loss of spontaneous reactions (39, 40).

Moreover, researchers are limited in observing the participants' body language and receiving nonverbal signals (39, 41). The hybrid process of deductive and inductive coding resulted in a rich number of constructs. The existing constructs of the CFIR provided a basis for identifying barriers and facilitators, but the new constructs "co-creation" and "peer collaboration" may be valuable additions to the CFIR within workplace settings (20, 42). Co-creation, also known as a "participatory approach" is also identified as a success factor for the implementation of WHPPs in other studies (43-45). In our opinion, the ratings are of added value, as they provide an overview of the valence and strength of the constructs. They are based on the input of the employers and reflect the frequency and consistency of themes raised during the focus groups. To avoid subjectivity in ratings, they were discussed extensively within the research team (46). Finally, as the domains of the CFIR are interrelated, it is difficult to make a clear distinction between the constructs as they can overlap. For example, both adaptability and co-creation aim to match the needs of the employees, but adaptability reflects a characteristic of the intervention and co-creation of the process in which the WHPP is developed and implemented.

Implications

The identified barriers and facilitators in all domains of the CFIR can help to reach effective implementation in future WHPPs. A WHPP that has high adaptability and matches the characteristics of the employees should be strived for. Moreover, since each work setting and employee population have their own inherent cultures and demands, thorough consideration should be given to these needs before implementing a WHPP. Therefore, it is crucial to involve management and employees in the implementation (7). Multiple channel communication and providing information continuously are key (29). This study builds upon the "Lombardy Workplace Health Promotion Network," an integrated WHPP that addresses different lifestyle themes within various domains. From this study, we have learned to involve all stakeholders, e.g., the caterer for adjustments in the staff canteen, professionals for delivering knowledge about health behavior, and supervisors to support and motivate employees. Furthermore, as factors influenced implementation in all domains of the CFIR, this emphasizes the importance of using an integrated approach to implementation that focuses on all levels. Future research could also incorporate the views of employers who have less affinity with workplace health promotion.

Conclusion

In this study, various barriers and facilitators in different domains play a role in the implementation of WHPPs in the Dutch context according to employers were identified. Several strategies that tackle the identified barriers and incorporate the facilitators should be put into practice for the successful implementation of integrated WHPPs.

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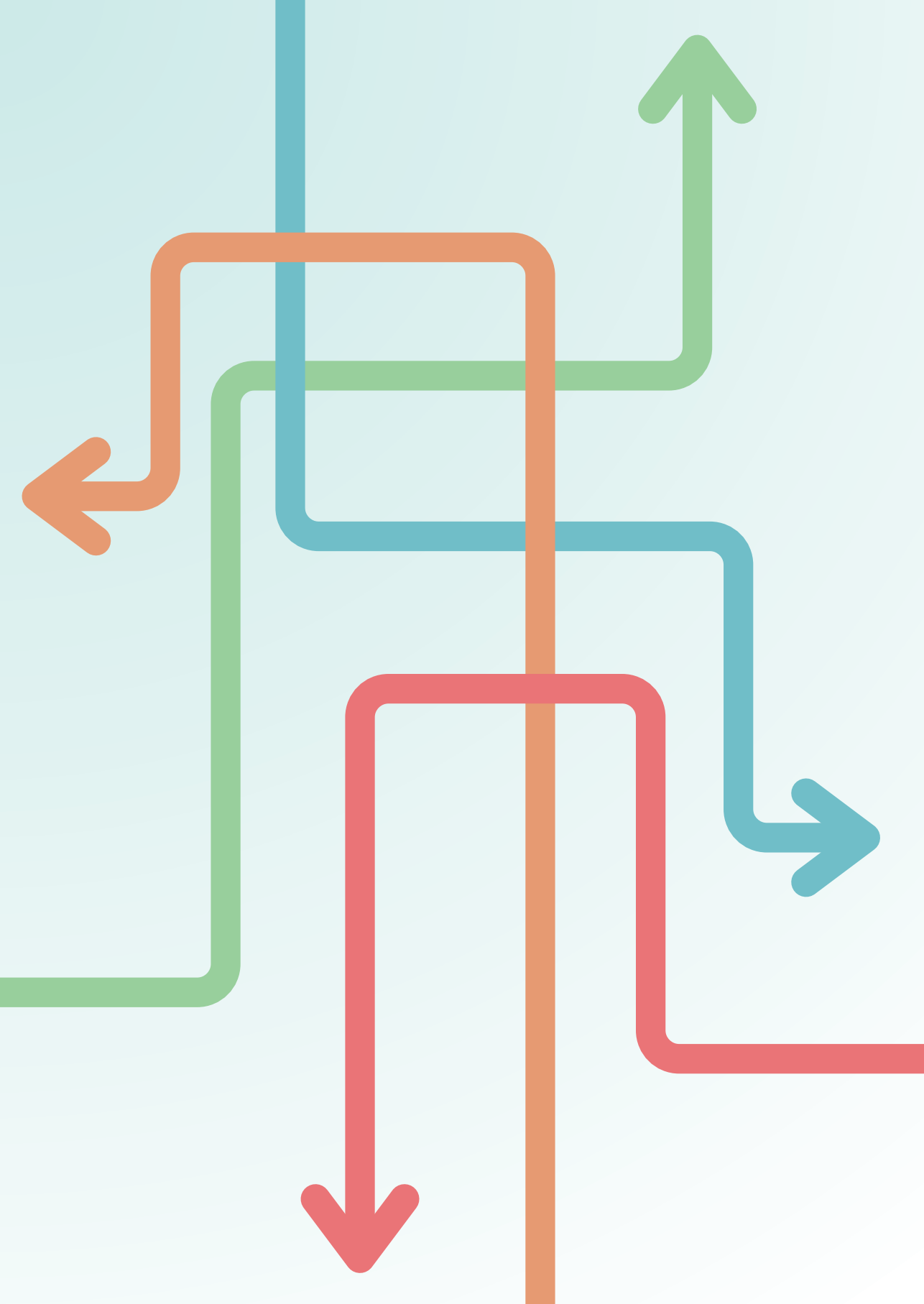

Part II

The evaluation of the integrated WHPP


5

Chapter 5

The implementation of an integrated workplace health promotion program in Dutch organizations: A mixed methods process evaluation

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Abstract

Objective: To gain insight into 1) the degree of implementation of an integrated workplace health promotion program (WHPP) 2) the perceptions of employers and employees regarding an integrated WHPP and 3) the contextual factors that hindered or enhanced implementation.

Methods: Data were collected by means of questionnaires, interviews among 19 employees, supervisors and HR-professionals, monitoring charts and observations at 6-10 months after the start of the implementation of the integrated WHPP. To evaluate the implementation process, ten process indicators from the evaluation frameworks of Nielsen & Randall and Wierenga were assessed. Descriptive analyses were performed for the process indicators as measured by questionnaires, monitoring charts and observations. Interviews with employers and employees were recorded, transcribed and then coded by two researchers independently by means of thematic coding.

Results: The results cover the following topics: implemented activities, the working group, engagement of employees, the role of management and policy and organizational preconditions. Although the criteria of the WHPP were not completely met, various activities were implemented in all participating organizations. Working groups consisting of Human Resources professionals, supervisors and employees, who selected and implemented activities, were composed within each organization. 22% of the employees did not feel involved in the implementation process. The absence of organizational policies regarding WHP hampered implementation. Organizations had the intention to continue with the integrated WHPP, which requires sufficient time and budget.

Conclusions: The implementation of the integrated WHPP appeared to be challenging and complex. Working groups indicated that they made the first important steps in integrating WHP in their organization and had the intention to continue with the implementation. However, to increase the impact, employers and employees should have the opportunity to implement and participate in WHP. Hence, organizational policies regarding WHP and active support of higher management are expected to be essential.

Introduction

Workplace health promotion programs (WHPPs) have been studied extensively, and despite proven effectiveness, evidence remains limited (1-3). Implementation of the WHPPs might play a significant role in this, as poor implementation, such as insufficient communication and adoption into practice can negatively impact effectiveness (4-8). To improve implementation and thus effectiveness of future WHPPs, it is of importance to study not only the effectiveness of these programs, but also the implementation process (4). First of all, process evaluations can provide insight in the factors contributing to the (lack of) effectiveness and the barriers and facilitators for implementation that play a role across different settings (4, 7, 9, 10). Secondly, a deviation from the original implementation plan does not exclusively lead to smaller effects, but can also achieve positive results, which will only be known when the implementation process is properly evaluated (5). Unfortunately, despite growing attention for the value of process evaluations, they are still being conducted sparsely (1, 4, 7, 10, 11). Murta et al. (2007) reported that process evaluations concerning WHPPs with a focus on stress management were often incomplete, lacked a theoretical framework and were not planned prior to implementation (12). This indicates that there is a need for systematically conducted, comprehensive process evaluations regarding WHPPs.

In this study the implementation process of an integrated WHPP to improve the overall lifestyle of employees was evaluated. In which lifestyle is defined as a combination of different health behaviors i.e. physical activity, nutrition, smoking, alcohol consumption and stress. The integrated WHPP of concern was built upon a European Good Practice, The Lombardy Workplace Health Promotion Network (LWHPN), and tailored to the Dutch context (13-15). One of the key elements of the integrated WHPP is that it includes activities at both the individual and organizational level for multiple health behaviors, e.g. physical activity and nutrition. Another key element of the integrated WHPP is the selection and implementation of activities that fit the organization and the needs of employees by a working group, consisting of HR, supervisors and employees, which is composed within each organization. In addition the working group creates awareness, enthusiasm and support within the organization. To examine whether these elements were actually applied in practice, the degree of implementation should be evaluated (4, 5, 16). For instance, the integrated WHPP may only yield a positive result when employees are aware of, participate in and actually receive the integrated WHPP as intended, i.e. including both key elements. Furthermore, to gain insight in the success or failure of the integrated WHPP, behaviors and perceptions of stakeholders should

be assessed. The motivation, knowledge, skills and opportunities of those involved in the implementation affect the actual implementation of the integrated WHPP (17). Furthermore, various contextual factors, i.e. organizational structure or culture and characteristics of stakeholders, might either hamper or support the implementation process (5, 18).

Hence, to illuminate the factors associated with success or failure of the integrated WHPP in practice, the aim of this study was to evaluate the implementation process of the integrated WHPP. Specifically, we provide insight in 1) the degree of implementation of the integrated WHPP, 2) the perceptions of stakeholders and 3) the contextual factors affecting the implementation of an integrated WHPP.

Materials and methods

Design

A mixed methods process evaluation was conducted alongside a two armed cluster randomized controlled trial (C-RCT) over a period of 6 to 10 months from baseline (between March 2022 and November 2023). For the C-RCT, randomization was carried out at the level of working locations, meaning that there was a control and intervention condition within each organization. Data were collected by means of an online questionnaire, interviews, monitoring charts and observations at the workplace.

The Medical Ethical Committee of the VU University Medical Center (VUmc, Amsterdam, the Netherlands) approved the study protocol (2021.0402). Written informed consent was obtained from all participants prior to commencing the study.

Study population

The integrated WHPP was implemented in four Dutch organizations in different occupational sectors (i.e. two educational organizations, an assurance, tax and consulting organization, and a retail organization). More details about the organizations are provided in Appendix 1. Organizations were recruited through the network of the project team members, co-workers and branch specific networks. Organizations could participate when they employed approximately 200 employees and did not yet implemented a WHPP comparable to the integrated WHPP, i.e. including activities on both the individual and organizational level for multiple health behaviors. Employees within these organizations were invited to

participate in the study. Within the first educational organization, only the ICT- and facility department participated. Employees were recruited between January 14th 2022 and March 29th 2023. See for more details about the study population and study design, the protocol paper (15). In the C-RCT 180 employees were included at baseline and those in the intervention condition (n = 90) received additional questions regarding the process evaluation in the questionnaire at six months. Interviews took place among a subgroup of the participants in the intervention condition. These employees were randomly selected using an online number generator, and received an e-mail from the researcher to invite them to participate in an interview. Moreover, one to three Human Resources (HR) professionals and/or supervisors, hereafter referred to as 'employers', from each organization, involved in the implementation of the integrated WHPP, were invited for an interview. Employers were recruited between December 14th 2022 and September 26th 2023

The integrated WHPP

Contact persons within each organization received 1) a catalogue with a varying range health promoting activities on both the individual and organizational level and multiple health behaviors (i.e. physical activity, nutrition, mental balance, sleep, smoking and alcohol consumption), based on the CHRODIS+ toolkit (19) and 2) an implementation plan to support successful implementation (15). As a first step, a working group consisting of HR professionals, employees and supervisors was composed within each organization. They selected and implemented activities in the intervention condition, based on needs and preferences of employees according to the criteria of the integrated WHPP. To meet the criteria of the integrated WHPP, they were asked to implement at least one activity at the individual and one activity at the organizational level, where both had to be performed for at least two health behaviors (Fig. 1) within six months after the start of the implementation (15). This means that in total four activities had to be implemented by each organization.

Implementation components

Three components of the implementation process, i.e. degree of implementation, perceptions of employees and employers and contextual factors, were assessed by ten process indicators from the evaluation frameworks of Nielsen & Randall and Wierenga (1, 20). Table 1 provides a detailed description of the implementation components and indicators, their definition and how and when they were measured. The first component included in this study is the degree of implementation, which comprises the following process indicators: implementation strategy (1), fidelity, dose delivered, dose received, recruitment and reach (20). Secondly, the perceptions of employees and employers were assessed following the process

indicators: satisfaction (20) and participants' mental models (1). The third and last component, contextual factors, consists of context and maintenance indicators (20).

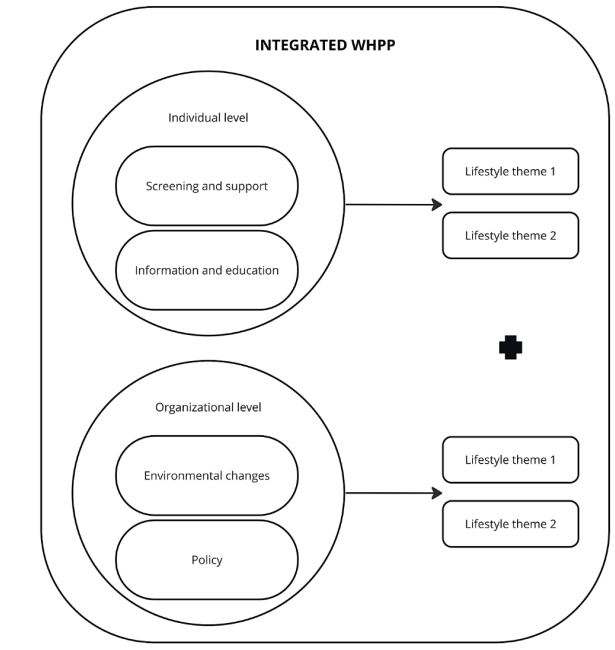

Figure 1. An overview of the integrated WHPP.

Regarding the contextual factors, the Consolidated Framework for Implementation Research (CFIR) was applied to analyze and report the data (21). The CFIR is a framework applied in implementation research and consists of five domains: 1) innovation, 2) outer setting, i.e. the external environment, 3) inner setting, i.e. the working environment, 4) individuals and 5) process. The Capability, Opportunity, Motivation, Behavior (COM-B) model, is integrated in the individuals domain of the CFIR (21, 22). COM-B can help to describe behavior of individuals by means of the interaction between capability (psychological or physical), opportunity (social or physical) and motivation (reflective or automatic) (22).

Data collection

Online questionnaires were completed by employees at six months follow up. Questionnaires were developed based on the process indicators (dose received, recruitment, reach, satisfaction, mental models and context) and included questions about 1) perceived involvement of employees in selection and implementation of activities and if implemented activities met their needs, 2) perceived support and commitment of supervisors during the program, 3) satisfaction and awareness

about implemented activities and communication channels used by implementers, 4) the extent to which employees participated in activities and 5) barriers and facilitators for participation, based on the COM-B model (physical and psychological capability, physical and social opportunity, automatic and reflective motivation). The answer categories, a five-point Likert scale ranging from 'totally disagree' to 'totally agree', were in line with those used in previous process evaluations or other studies (23, 24).

Around 8-10 months after the start of the implementation of the integrated WHPP, semi-structured interviews were conducted with employees (both employees who were part of the working group and employees who were not) and employers i.e. HR professionals and supervisors who were part of the working group. A preliminary plan about the sample size of interviewees included to interview two employees, one employee in the working group and two employers. However, deviations of this plan could occur and depended on for instance the size of the organization, willingness to participate and data saturation. The interview guideline for employees consisted of questions about 1) if employees participated in activities or not and for what reason, 2) which communication channels were used according to employees, whether they thought these channels were suitable and if they appreciated the use of these channels, 3) their attitude towards and believe in the integrated WHPP, and 4) their satisfaction about the integrated WHPP. The employer interview guideline included questions regarding 1) the roles and behaviors of implementers, 2) their attitude towards and believe in the integrated WHPP, 3) use of the program materials, i.e. the catalogue and implementation plan, 4) perceived barriers and facilitators for implementation, and 5) satisfaction and motivation to continue with the integrated WHPP. Both guidelines were developed based on process indicators as depicted in table 1.Interviews were conducted by DS. If DS was familiar with the interviewee, another researcher conducted the interview, to mitigate potential bias.

A monitoring chart was completed by one member of each working group from the start of the implementation of the integrated WHPP (Appendix 2). In these monitoring charts the implemented activities, the amount of time necessary to implement activities, timing of implementation and the applied communication strategies to inform employees about activities were registered.

Observations were done per location for each organization. For one organization a sample of the locations was visited, due to the large number of separate locations throughout the country. One of the researchers conducted the observations by

means of a checklist to assess 1) adjustments to the physical working environment and 2) visible communication concerning adjustments or activities, i.e. posters and flyers. These observations took place at baseline and 7-10 months after the start of the implementation, to assess which adjustments to the physical working environment were implemented and how they were implemented and to which extent visible communication, such as flyers or posters about activities was present.

Data analysis

A combination of both qualitative and quantitative data was used to determine the process indicators. Descriptive analyses were performed using the questionnaire data. Interviews with employers and employees were recorded and transcribed verbatim. The transcripts were coded by means of thematic coding. An initial codebook was drafted based on the applied frameworks, i.e. Wierenga, Nielsen & Randall, CFIR and COM-B, and new codes could emerge from the data. The first two transcripts were coded independently and discussed by two researchers. The remaining transcripts were coded by one researcher and checked by the other. Next, all coded transcripts were discussed until consensus between the two researchers was reached. If necessary, a third researcher was consulted. Information from the monitoring charts was used to determine the number of activities implemented within the different health behaviors on both the individual and organizational level. Information about adjustments to the physical working environment was derived from the checklists completed during the observations. To assess the dose received, the percentage of employees that participated in at least one individual-based activity and the percentage of employees that were exposed to an adjustment at the organizational level was determined. In case employees participated both in an individual-based activity and were exposed to an adjustment at the organizational level for at least two health behaviors, they were considered as compliant to the integrated WHPP and thus received the complete WHPP. MAXQDA software was used to analyze the qualitative data and analyses of quantitative data were performed using the Statistical Package of Social Sciences version 28.0 (SPSS Inc, Chicago, IL).

Table 1. Overview of implementation process indicators that were measured among employees, supervisors or HR professionals or were observed at the workplace including the definition and the timing of the measurement from baseline.

Main implementation process component	Process indicator	Definition	Employees		Supervisor/HR		Workplace	
			Questionnaire	*Interviews*	*Interviews*	*Monitoring charts*	*Observations*	
			6 months	7-10 months	7-10 months	6 and 8-10 months	Baseline	7-10 months
Degree of implementation	Implementation strategy	*Roles and behaviors of key stakeholders, i.e. members of the working group*			X	X		
	Fidelity	*Compliance to the integrated WHPP and use of the catalogue andimplementation plan*			X	X		
	Dose delivered	*Number and type of activities implemented by the employer*				X	X	X
	Dose received	*Proportion of employees that received the integrated WHPP*	X	X		X		
	Recruitment of employees	*Sources and procedures used to stimulate participation of employees in activities*	X	X		X	X	X
	Reach	*Proportion of employees who were aware of the implemented activities*	X	X				
Perceptions of employees and employers	Satisfaction	*Opinion and satisfaction of employees and employers about the implemented activities and its implementation*	X	X	X			
	Participants' mental models	*Perceptions and appraisals of employees and employers about the integrated WHPP*	X	X	X			
Contextual factors	Context	*Barriers and facilitators perceived by employees and employers for participation and implementation respectively*	X	X	X			
	Maintenance	*Prerequisites for continuation of the integrated WHPP according to employers*			X			

Results

The questionnaire at six months follow-up was completed by 81 employees (90%). Mean age of the participants was 42.5 (11.6) years and 57.8% was female. Three organizations each delivered one monitoring chart. One organization had three local working groups and thus delivered three separate monitoring charts, leading to a total of six monitoring charts. A total of 11 employees across the 4 participating organizations were interviewed, of which three were part of the working group of their organization. Eight employers, all involved in working group of their organization were interviewed, details are depicted in Table 2 and 3.

Table 2. Information about interviewees (employees).

Employees	Organization	Male/female
1	1	Female
2	1	Male
3	2	Male
4	2	Male
5	3	Male
6	3	Male
7	3	Female
8	4	Male
9[a]	1	Female
10[a]	2	Female
11[a]	2	Female

[a] Employees who were part of the working group of their organization.

Table 3. Information about interviewees (employers).

Employers[a]	Organization	Male/female	HR/supervisor
1	1	Female	HR
2	1	Female	Supervisor
3	2	Female	HR
4	2	Female	HR
5	2	Female	Supervisor
6	3	Female	Supervisor
7	3	Female	Supervisor
8	4	Male	HR

[a] Human Resources (HR) professionals and/or supervisors.

Implemented activities

The implementation of activities on both the individual and organizational level for multiple health behaviors was a key element of the integrated WHPP. Nevertheless, none of the organizations met the criteria of the integrated WHPP six months after the start of the implementation. Organizations did implement activities within at least two health behaviors, but the activities were implemented not on both the individual and organizational level. Two organizations reached almost full compliance to the integrated WHPP at six months. They implemented activities at both the individual and organizational level for one health behavior, and an activity implemented on either the individual or organizational level for another health behavior (Appendix 3). Another organization implemented one activity on the individual level, that encompassed multiple health behaviors. As none of the organizations managed to implement the integrated WHPP as intended at six months follow-up, the percentage of employees that received the integrated WHPP was zero. Eight to ten months after the start of the implementation, additional activities were implemented by two organizations. However, the criteria of the integrated WHPP were still not met (Appendix 3). Activities at the organizational level mainly consisted of adaptations to the work environment, rather than policy adjustments. Based on the observations at the workplace, it appeared that all of the adaptations to the physical work environment, such as replacement of sodas, were implemented as reported. Possible explanations for not meeting the criteria of the integrated WHPP lie within the implementation process, which is described through the degree of implementation, perceptions of stakeholders, and contextual factors within four relevant themes i.e. composition and functioning of the working group, engagement and participation of employees, the role of management and policy and organizational preconditions.

Composition and functioning of the working groups

One of the key elements of the integrated WHPP was the working group, consisting of HR, supervisors and employees, that selected and implemented activities from the catalogue. The working group could also create awareness about the activities and promote participation.

Degree of implementation

In each organization working groups were composed to implement the integrated WHPP. The interviewed employers indicated that contact persons in the organization sent out a call through various channels to recruit members for the working groups. They also approached employees and supervisors personally. Each working group had one or two group leaders, which were set by the members

themselves. The division of roles within the working group, e.g. planning, execution, leadership, overall came naturally, such as on the basis of the role someone occupied within the organization. During meetings of working groups, ideas for health promotion activities were generated and discussed, achievements were evaluated and the implementation process was planned. All of the working groups used the catalogue to get inspired and to select activities. Overall, working groups collectively – during the working group meetings – selected activities from the catalogue within the health behaviors of interest, based on how easy they could be implemented. Working groups either used the implementation plan to check their progress or used it as a tool to initiate the process, but did not systematically follow every step. As a result, not all steps were conducted. For instance two out of four organizations identified health behaviors of interest by conducting a needs assessment among employees by disseminating an (online) survey. The other two organizations identified relevant health behaviors with the members of the working group. Mainly due to time constraints they did not conduct a needs assessment. However, the needs assessment was expected to be of added value, because of the insights it yielded regarding relevant health behaviors and suitable timing of activities according to both employees and employers. The working group informed employees about the activities through email (56%), internal websites (21%) and newsletters (17%) according to questionnaire data.

Perceptions of stakeholders (working group members)

Working group members were positive about the integrated WHPP. They recognized the working group as an essential and helpful component of the integrated WHPP:

> *"Researcher: If you could mention one aspect of the program that has been most helpful, what would it be? Employer: Those working groups. Absolutely! Despite what I just said, that it [number of implemented activities] is not enough. But you create ambassadors throughout the organization through such a working group, so to speak. Even if no concrete actions would have emerged, at least it initiates discussions. And I think that's already a major success. So, despite the limited outcomes in activities, I truly believe it makes a meaningful contribution." – Employer 8*

In some cases, enthusiasm about the integrated WHPP had to grow. Two working group members indicated that at the start they were skeptical about the integrated WHPP and expected that implementation of activities would entail a lot of work. However, during the implementation process and upon viewing the catalogue their view about the integrated WHPP changed in a positive way:

> *"You see, initially, you think: oh, what do we have to do? But then, when you take a look at that intervention [catalogue], that menu you [researcher] provided, you realize that you've accomplished something fairly rapidly, I believe. It's actually quite accessible. You should not complicate it too much." – Employer 7*

Working group members indicated that the catalogue served as a source of inspiration and that it was a clear and comprehensive tool. Moreover, the categorization into themes was perceived to be convenient:

> *"Well, I found the toolkit [catalogue] to be very comprehensive. I also appreciated that she [researcher] organized it into different categories, so you can see: what happens in each category? And the toolkit was more accessible than I had expected. Many of the interventions listed in it were actually quite easy to implement. Because we had a limited budget and little support, it made things [implementation] easier." – Employer 6*

Contextual factors

Working group members mentioned in the interviews that they did not always had the opportunity to implement activities, primarily due to a lack of time. They implemented the activities in addition to their regular work.

> *"Everyone recognizes its [vitality at work] importance, but daily priorities are simply being set. And that's unfortunate. So is it a matter of time, or is it a matter of workload? Well, that's the question. But because of that, we do fall behind, that's for sure." – Employer 8*

Despite their limited time, working group members were enthusiastic and motivated to work with the integrated WHPP and were hoping to dedicate more time to it. A perceived facilitator by working group members, was collaborating in a working group consisting of various representatives within the organization, i.e. employees, supervisors and HR-professionals:

> *"I believe it's great when within a group, you have things to dream about, to think through, to explore possibilities. But it's also very valuable to have people who truly consider the reality, like what is feasible and what is not. I see that reflected in the working group as well." – Employer 1*

A barrier according to employers was that composing the working groups within the organization was time consuming, amongst others as it was not always clear who was in charge and due to high work demands. As a result, several months in which activities could have been implemented had been lost. Moreover, (not) having working group members with specialized knowledge and in the right places, both physically (at a particular location, or a floor in a building) and in terms of position in the organization (e.g., a supervisor, head of department or office manager) could either hamper or support implementation of the integrated WHPP.

Engagement and participation of employees

Employee engagement was essential in the implementation of the integrated WHPP. Hence, the implementation plan emphasized the involvement of employees in the working group and the necessity of assessing their needs regarding activities and timing which was expected to improve participation.

Degree of implementation

With regard to the awareness and participation of employees about the integrated WHPP, 72% of the employees indicated that they were aware of the integrated WHPP that was implemented in the context of the study. However, only 14% and 16% of employees used the environmental adjustments or participated in activities respectively. During interviews, employees were unable to recall implemented activities. However, when implemented activities were listed by the researcher, employees recognized and, in some cases, had participated in them.

Perceptions of stakeholders (employees)

Employees who were a member of the working group mentioned that they enjoyed being a part of it, as they felt involved. They also indicated that they were more inclined to set a positive example. However, one employee who was not part of the working group noticed how involved the working group was, but mentioned that this did not extend beyond the working group:

> *"Interviewer: Do you feel that employees were involved in the process of selecting and implementing activities?Employee: No. No, I haven't heard much about that. I believe that's something that stayed within the working group mostly […]. Well, that remained quite internal, I think." – Employee 4*

The questionnaire, completed by employees, provided information about the opinions and appraisals of the employees about the integrated WHPP. In the questionnaire, employees rated the integrated WHPP with a 6.4 (2.2) on a scale of

1-10 on average. Results from the questionnaire also imply that almost a quarter of the employees (23%) did (totally) disagree with the statement that the integrated WHPP met their needs. Less than half of the employees (44%) indicated that the workplace did not become healthier, and a comparable percentage (41%) reported that they did not adopt a more healthy lifestyle. 22% of the employees did not feel involved in the implementation process. Fig. 2 shows results on opinions and appraisals of employees about the integrated WHPP.

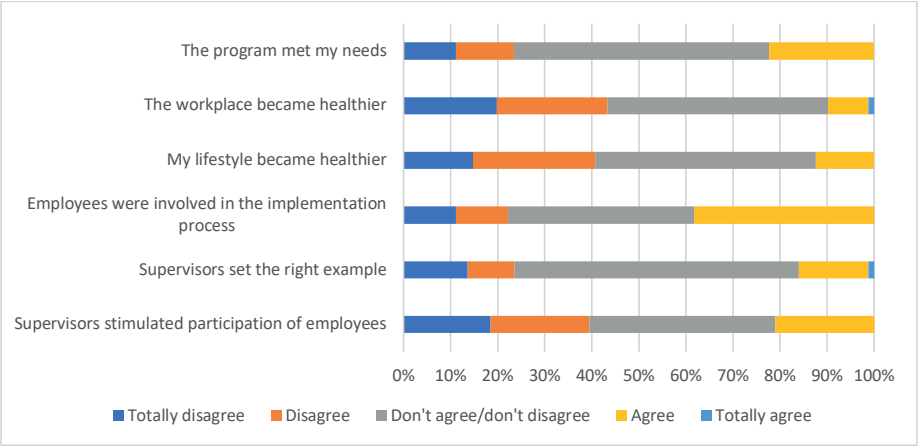

Figure 2. Questionnaire data regarding opinion and appraisals of employees about the integrated WHPP.

In the interviews, employees indicated that only a small number of activities was implemented, which they found unfortunate. However, they were satisfied with the non-committal nature of the integrated WHPP, as this allowed them to choose whether they wanted to participate in implemented activities or not. When participation is imposed or obligatory, it can actually hinder participation:

> *"So I don't necessarily want something imposed on me. I still want to be able to make a choice. And as long as I can make that choice, nine times out of ten, I'll try to make the right one. But I've had the experience myself: if something is going to be imposed on me, then I become stubborn" – Employee 1*

Contextual factors

Contextual factors such as opportunity and timing of activities affected the participation of employees in the implemented activities. Questionnaire data indicated that 30% of the employees had sufficient knowledge and information to participate in activities. Almost a quarter (23%) of the employees did not have sufficient time to participate in implemented activities and a majority of the

participants indicated that they already have a healthy lifestyle (76%). Almost all employees (92%) agreed with the statement that a healthy lifestyle is important, which was therefore perceived as an important motivation to work on a healthy lifestyle (Fig. 3).

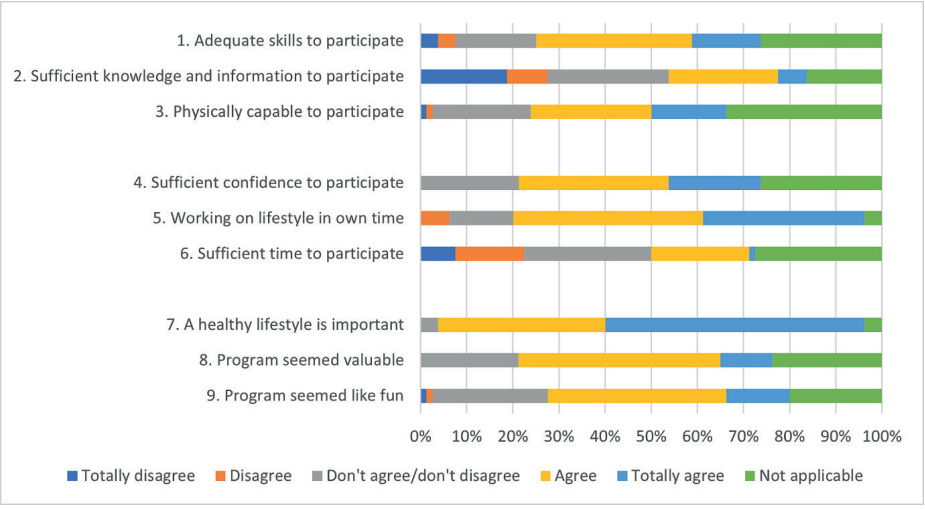

Figure 3. Employees' capability (1-3), opportunity (4-6) and motivation (7-9) to participate in activities, based on the COM-B model.

The scheduling of activities was perceived as a barrier for participation. Employees indicated that they did not participate in activities that did not take place adjacent to working hours.

The role of management and policy

Based on information from both questionnaires and interviews, the role of management i.e. higher management and supervisors, and organizational policies appeared to be important in the implementation of the integrated WHPP.

Perceptions of stakeholders (employees)

Regarding the role of supervisors, it became apparent that an adequate balance has to be found in stimulating participation in WHPPs. That is, as soon as employees feel that something is imposed or decided by their supervisors, or that there is some form of peer pressure from colleagues, they are not willing to participate anymore:

> *"But as soon as there's actually some kind of expectation expressed by a supervisor, I think that's very quickly interpreted as if your supervisor, from his position, also expects you to do this and that you're not doing*

your job well if you don't participate. And yes, that's the line that I think you shouldn't cross." – Employee 6

In the questionnaire, 40% and 24% of the employees (totally) disagreed with the statement that supervisors stimulated participation of employees in activities implemented as part of the integrated WHPP and that supervisors set the right example, respectively (fig 2).

Contextual factors

A barrier that affected the implementation of the integrated WHPP was the absence of organizational policies regarding vitality, e.g. including vitality activities in organizational long-term plans, encouraging cycling to work by providing incentives or compensations, ensuring a healthy caterer for the company restaurant and organizational events. For this reason, activities were perceived by employees as separate initiatives without consistency, which was perceived as a barrier for participation:

"I expected that there would be more structured events at specific times, including after working hours, to make it more dynamic. In my opinion, it's not really a cohesive program where you can engage seamlessly. They are more like isolated activities. I expected more coherence" – Employee 6

Nevertheless, some employers thought of the implementation of the integrated WHPP as a proactive signal to the organization, emphasizing the value of WHP through concrete actions while others observed increased awareness and recognition of WHP within the organization as a result of the integrated WHPP. Overall, working group members felt support from higher management, e.g. the board of directors, which was identified as a facilitator for implementation. Yet, according to working group members, a more active role of higher management could induce more effect, e.g. by setting a good example.

Organizational preconditions

Lastly various organizational preconditions appeared required for successful implementation of and participation in the integrated WHPP, not all of them were present in the participating organizations.

Perceptions of stakeholders (employers and employees)

The organizational culture and employees' willingness to engage are examples of organizational preconditions. Employees in organizations were generally positive

about the organization offering WHP, and are open to participating, given the availability of time, which was not always the case. Furthermore, overall lifestyle, comprising a combination of different health behaviors, was seen as a personal choice and responsibility. Although, employers do have a responsibility to facilitate a healthy lifestyle for employees by providing opportunities, e.g. options to exercise at work or get a healthy lunch, and ensuring a healthy environment, e.g. with fruit, sit-stand desks or lunchtime walks. However, imposing these measures would hinder participation.

> *"I think so, although it may quickly be seen as intrusive. But I do think that an employer can provide tools, offer opportunities like: we offer you the opportunity, for example, to talk to a sports coach or a dietitian. I believe that an employer can definitely play an important role in that." – Employee 8*

The bureaucracy within the organizations challenged the implementation of the integrated WHPP according to multiple employers. For example, when placing stickers to promote taking the stairs, meeting numerous requirements and navigating through various layers of the organization were necessary before actual implementation could occur. During the implementation process one employer recognized the importance of embedding activities and plans in the annual or long-term plans.

Contextual factors

For successful implementation local needs within the organization or working location should be considered. Employers indicated that the multifaceted nature of the integrated approach enabled them to tailor activities to preferences and needs of employees, which facilitated implementation. Almost all employers reported the research context as a barrier for implementation, as the presence of a control condition, restricted the number of communication channels that could be used. Additionally, some activities, such as adjustments to the physical work environment or implementation of policies, were difficult to implement in the intervention condition only. Hence, working groups strived to select activities that could be implemented in the intervention condition only and opted for communication channels exclusive to the working locations in the intervention condition. Moreover, employers indicated that it was hard to accept that they could not offer activities to all employees, since sick leave rates also had to be reduced in the control condition. On the other hand, organizations have taken initial steps in implementing WHP, due to the study. Despite the challenges with

the implementation, all of the organizations had the intention to continue with the implementation of the integrated WHPP. In doing so, they indicated that policies regarding vitality, greater awareness and familiarity, time and budget are necessary.

Discussion

The aim of this study was to evaluate the implementation process of the integrated WHPP by assessing the degree of implementation, perceptions of employees and employers and contextual factors affecting implementation. Based on the findings, it can be established that the key elements of the integrated WHPP were not entirely manifested in practice, several factors within four themes relevant to the implementation process i.e. the composition and functioning of the working group, engagement and participation of employees, the role of management and policies and organizational preconditions, contributed to this. Although organizations were able to establish a working group consisting of HR professionals, supervisors and employees, this process entailed a considerable amount of time, which substantially delayed the implementation of activities. Additionally, working group members indicated that they experienced a lack of time to actually select and implement the activities. A positive factor was that working group members were motivated and satisfied with the integrated WHPP. They reported the multifaceted nature of the integrated WHPP as a facilitator and the absence of policies regarding vitality as a barrier for implementation. Overall, the process of composing a working group and selecting and implementing four activities according to the criteria of the integrated WHPP within six months, was not feasible for the organizations.

From our findings, it appeared that both working group members and employees did not always had the opportunity to implement or participate in activities respectively, which was mainly due to a lack of time and/or other priorities. As this might be related to the organizational culture and the absence of policies concerning vitality, a shift to a culture where (working on) a healthy lifestyle is the standard and not the exception, is essential (25-28). In our study, the absence of organizational policies concerning vitality also made it challenging to implement activities with regularity and coherence, which is another factor that underlines the need for such policies. These policies might involve including vitality activities in organizational long-term plans, encouraging cycling to work by providing incentives or compensations, ensuring a healthy caterer for the company restaurant and organizational events and can contribute to a supportive organizational culture regarding WHP (29). In the current integrated WHPP activities at the

organizational level could either comprise adjustments to the social or physical working environment or adjustments to policies, making the adjustments of policy optional. To enhance the implementation of policies regarding health and vitality, it might be beneficial to incorporate a mandatory component concerning policy adaptation in the integrated WHPP, eliminating the optional aspect.

The implementation of policies requires actions of higher management, which is why commitment and support of higher management towards WHP is of importance (30). In our study, higher management was committed and did approve the implementation of activities in the organization. However, employers indicated that a more active role of higher management, e.g. active involvement in shaping the WHP offer, embed vitality in policies and the mission of the organization and actively promoting the importance of vitality within the organization, in the implementation could potentially enhance the success of the implementation. Multiple other studies underline the importance of active support from higher management, on both the level of implementation and participation of employees in activities (6, 30-36). A WHPP in Andalusia, Spain, also based on the Lombardy Workplace Health Promotion Network (LWHPN), identified commitment of higher management as a strength for the implementation as they allowed employees to dedicate working time to participate in activities (37). In future studies, it is therefore recommended to promote active involvement and continuous commitment of higher management in the implementation of a WHPP. An accreditation process, included in both the LWHPN and Andalusian WHPP might also have accounted for a boost in motivation of higher management to implement the WHPP. Therefore it might be valuable to include this in future updates of the integrated WHPP under study (37).

Also factors positively affecting the implementation were observed in this study. Even though it took a significant amount of time to get the working group up and running, members of the working group valued working together on vitality in a multidisciplinary team. Employees in the working group felt involved, which is known to positively affect their engagement in WHP (30, 35, 38). Moreover, members of the working group were very motivated to work on this project and individual characteristics such as motivation and commitment are known to attribute to an individual's suitability of implementing and maintaining WHP activities (32). However, only a limited number of employees can be directly engaged in a working group. Moreover, results of our study indicated that the working groups were not that visible for other employees and that their enthusiasm did not always transfer to the other employees. Hence, additional efforts may be necessary to

adequately involve other employees. This might involve utilizing regular meeting times to identify employee needs in a more personalized manner than through a questionnaire, ongoing communication, utilizing various communication channels, about what is done with these identified needs and increasing the visibility of the working group so that the threshold for employees outside the working group to submit ideas is lower. For future implementation of WHP the formation of a working group with motivated members is encouraged as it might improve the reach, participation and support of the WHPP throughout the organization, on the condition that working group members clearly present themselves as ambassadors (17, 18, 30, 39).

Employees rated the integrated WHPP with a 6.4 out of 10. A possible explanation for the fact that the integrated WHPP was not graded higher is that initial steps towards WHP were taken and the program therefore was not always visible to the employees. The low participation rate also implies a lack of awareness of employees about the specific activities implemented in the context of the study. Moreover, the low number of implemented activities and the low percentage (22%) of employees that felt their needs were met, might account for the relatively low rating of the integrated WHPP by employees. To align more closely with the needs of employees, a more diverse set of activities could be implemented based on a proper needs assessment. Even though a needs assessment was recommended in the implementation plan, only two organizations actually conducted a needs assessment (17, 18). Another previously identified facilitator that potentially lacked attention during the implementation of the integrated WHPP, was support from supervisors (17, 18). This might be partially attributable to the adequate balance that has to be found for supervisors in stimulating participation in WHP without imposing it. Informing supervisors about implemented activities and raising their awareness with regard to the role-model position they have is an important task of the working group which requires further attention in future implementation of WHPPs. This might be achieved by providing supervisors with a training about their role regarding vitality at work, how they can stimulate employees to participate in activities, without imposing it and to enhance their ability to serve as a role model (40).

Strengths and limitations

A strength of this study was the mixed methods study design. The combination of data from interviews, questionnaires, monitoring charts and observations provided us insight in the implementation process of the integrated WHPP. Moreover, it was observed that data saturation was achieved in the interviews, indicating

that sufficient information was collected. Another strength is that the integrated WHPP was implemented in four varying occupational settings, enriching the data as different factors within each implementation component were observed. As mentioned in the introduction, Murta et al. (2007) reported a high number of process evaluations being incomplete, lacked a theoretical framework and were not planned prior to implementation (12). As the current process evaluation has been reported following two frameworks, was planned in advance and is complete, by reporting on the degree of implementation, perceptions of stakeholders and contextual factors, this can be seen as a strength. A limitation is that the implementation of the integrated WHPP is potentially affected by the C-RCT conducted to analyze the effect of the integrated WHPP on overall lifestyle, which is also reported in other studies (41, 42). For instance, employers indicated that implementation was difficult because of the control condition, especially on the organizational level. Additionally, they experienced difficulties in communication as many channels were used organization-wide and are linked together. Moreover, employers experienced time pressure from the study, due to scheduled measurement moments. Resulting in an unnatural process and a focus on the practical part of the implementation, rather than tailoring activities to the needs of employees. For future studies, it may be worthwhile to consider other study designs than an RCT, such as a stepped wedge design, where all participants receive the intervention (41, 42). Another limitation is potential bias in the questionnaire, as employees might have confused the integrated WHPP (intervention) with the research they participated in (e.g. answering questions about communication from the research perspective instead of the intervention perspective or vice versa). Moreover, it is possible that there was selection bias as participants in this study might be predominantly employees with a positive attitude towards WHPPs. Participating organizations were motivated and willing to implement the integrated WHPP and employed predominantly highly educated employees, potentially leading to selection bias and limited generalizability, especially given the limited number of participating organizations.

Conclusion

This process evaluation indicates how challenging and complex successful implementation of WHPPs in organizations is. Important lessons learned for implementation of (integrated) WHPPs include the importance of organizational policies concerning vitality, and the necessity for implementers to have sufficient time and thus the opportunity to prioritize the implementation of activities. Despite this challenged implementation of the integrated WHPP in practice, the program

was well received by the working groups and they all had the intention to continue with the implementation. Achievements mentioned by the working groups, such as stressing the importance of WHP through concrete actions and facilitating conversations about workplace vitality, are important first steps for a successful implementation of WHP. However, based on insights from this process evaluation, an organizational culture where attention to vitality is part of the organization's identity is needed to successfully implement WHP and to make a greater impact on the targeted health behaviors of employees.

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Appendices

Appendix 1

Table A1. Characteristics of the participating organizations.

Organization	Occupational sector	Number of employees	Locations
1	Educational organization	319[a]	2
2	Assurance, tax and consulting organization	639	7
3	Educational organization	197	4
4	Retail organization	256[a]	27[b]

[a] Number of employees in participating departments within the organization. [b] Divided over four regional clusters.

Appendix 2

Table A2. Template of a monitoring chart.

Implemented activity	
Name activity	
Short description activity	
Lifestyle themes	
Select the lifestyle theme(s) targeted by the activity	
Levels	
Select the level (individual or organizational) on which the activity is implemented	
Time	
How long did the implementation process take	
Date: start of implementation	*Date: activity implemented*
How many hours per day/week/month were spent on the implementation	
Hours	*Per day/week/month*
Communication to employees	
Describe how employees were informed about the activity	
Sessions	
If applicable: how many sessions were included in the activity	
Number of sessions	
How many employees participated in each session	
Session	*Number of participants*

Appendix 3

Table A3. Overview of activities implemented 6-10 months after the start of the implementation.

		Organization 1	Organization 2	
Location			**1**	**2**
Physical activity	*Individual level*	Infographic informing employees about the WHP offer regarding physical activity[a]	Microsoft Teams channel to schedule exercise activities with colleagues[a]	Microsoft Teams channel to schedule exercise activities with colleagues[a]
		Motivating quotes at digital screens and posters[b]		Encourage participation in a city run[b]
	Organizational level	Nudges to increase use of the stairs instead of the elevator (stairs)[b]		
Nutrition	*Individual level*	Infographic informing employees about the WHP offer regarding nutrition[a]	A tasting of healthy syrups (to replace sodas)[a]	A tasting of healthy syrups (to replace sodas)[a]
		Motivating quotes at digital screens and posters[b]		
	Organizational level		Healthy syrups and a water tap with cold and sparkling water to replace sodas[a]	Healthy syrups and a water tap with cold and sparkling water to replace sodas[a]
			Healthy options during lunch[a]	An expansion of fruit offered at the workplace, both in diversity and quantity[b]
			Healthy snacks during meetings and gatherings[a]	

		Organization 3	Organization 4
	3		
	Microsoft Teams channel to schedule exercise activities with colleagues[a]	Exercise workshops organized by ambassadors[a]	
		Exercise activity after personnel day[a]	
		Active personnel days[a] Policy to include exercise activities, workshops and active personnel days in annual agenda plans[b]	More options (i.e. different sports) in how to spend the vitality budget[a]
	A tasting of healthy syrups (to replace sodas)[a]		Information about the importance of healthy nutrition, accompanied by vitamin C tablets[b]
	Healthy syrups and a water tap with cold and sparkling water to replace sodas[a]	Active personnel days[a]	
		Policy to include active personnel days in annual agenda plans[b]	

Table A3. Continued

		Organization 1	Organization 2	
Location			**1**	**2**
Mental balance	*Individual level*	Infographic informing employees about the WHP offer regarding mental balance[a] Motivating quotes at digital screens and posters[b]	Promote employees to support colleagues participating in a city run[a]	
	Organizational level			'Shuffle Tuesday' everyone sits at a different desk to meet other colleagues[b]
Smoking	*Individual level*			
	Organizational level			
Alcohol	*Individual level*	Infographic informing employees about the WHP offer regarding alcohol consumption[a] Vitality quotes at digital screens and posters[b]		
	Organizational level			
Sleep	*Individual level*	Motivating quotes at digital screens and posters[b]		
	Organizational level			

[a] Activities implemented six months after the start of the implementation. [b] Activities implemented 8-10 months after start of the implementation

		Organization 3	Organization 4
	3		
			Information on regulations and opportunities around taking leave[a]
			Availability of a budget coach[a]
			Informing and stimulating supervisors by management to have an open dialogue on work-life balance with employees (including taking days off)[a]


6

Chapter 6

Effectiveness of an integrated approach for workplace health promotion on lifestyle of employees: Results of a cluster randomized controlled trial

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Submitted

Abstract

Background: Evidence for the effectiveness of workplace health promotion programs (WHPPs) is small to moderate. More impact can be expected from an integrated WHPP, including activities at the individual and organizational levels. Since evidence regarding the effectiveness of integrated WHPPs is scarce, the aim of this study was to evaluate the effect of an integrated WHPP on the lifestyle of employees.

Methods: A two-armed cluster randomized controlled trial with measurements at baseline and at six and twelve months of follow-up was conducted. The intervention consisted of health promotion activities aimed at two (out of six) health behaviors, targeting the individual and organizational levels. The main outcome was an overall lifestyle-score measured using twelve items from the Simple Lifestyle Indicator Questionnaire. The secondary outcome measures were six separate health behaviors, i.e. physical activity, nutrition, mental balance, smoking, alcohol consumption, and sleep. Intervention effects at six and twelve months were analyzed by conducting either longitudinal linear or (ordinal) logistic multilevel analyses, or generalized estimating equations.

Results: A total of 173 employees from four organizations participated. No effect was observed for overall lifestyle. The consumption of sugary drinks was higher over time (OR: 2.4, 95%CI: 1.1 – 5.4) and after twelve months of follow-up (OR: 2.9, 95%CI: 1.03 – 8.0) for the intervention condition compared to the control condition.

Conclusions: The integrated WHPP was not effective in improving the lifestyle of employees. The short duration of employees' exposure to activities, poor implementation (i.e., not meeting the criteria of the integrated WHPP), and the minimal implemented activities may explain the absence of effect.

Trial registration: LTR (onderzoekmetmensen.nl), NL9526. Registered on 3 June 2021.

Keywords: Integrated approach, simple lifestyle indicator questionnaire, worksite health promotion, cluster-randomized controlled trial, health behaviors

Background

In the past decades, workplace health promotion programs (WHPPs) have often been deployed to improve the lifestyle and health of employees and their effectiveness has been studied extensively (1-6). Nevertheless, evidence on the effectiveness of WHPPs is small to moderate and the effects are not always lasting (3, 5, 7). One of the causes might be that a majority of the WHPPs targets the individual level only (3, 5, 8). However, when promoting a healthy lifestyle, the focus should not be solely on the individual. Healthy behavior is a combination of both conscious and nonconscious choices (9). Conscious choices might be affected by providing activities focused on the individual level, e.g., information provision, counseling and workshops. Whereas nonconscious choices can be influenced through the environment by mitigating barriers and increasing opportunities for healthy behavior (9). For example, activities at the organizational level, such as reducing the availability of soft drinks or providing equipment to stimulate active meetings, could be implemented. Hence, in addition to activities targeting the individual, a work environment that supports healthy choices contributes to the success of the adoption of healthy lifestyle behaviors (6, 9, 10). The importance of a supportive work environment has been confirmed in a recent study, which showed that colleague encouragement and colleague behavior play a role in the participation rate of WHPPs, i.e. the use of healthy menus and sport facilities (11). Additionally, support from supervisors has been found to be important in improving the uptake of WHPPs (12-14). WHPPs often focus on one health behavior, e.g., through a physical exercise or mindfulness intervention (3, 5). However, health behaviors are often intertwined. Hence, targeting multiple health behaviors within one WHPP might yield greater effects (2). For instance, to reduce body weight, a combination of healthy diet and sufficient PA might be most effective, and poor nutrition might affect sleep quality (2, 4, 15).

A WHPP that targets both the individual and organizational levels and multiple health behaviors simultaneously is considered an integrated WHPP (16). The Lombardy Workplace Health Promotion Network (LWHPN) is an example of an integrated WHPP, which is recognized as a good practice in the occupational setting in the European Joint Action CHRODIS (16, 17). In the LWHPN, participating organizations received a catalogue with health promoting activities for multiple health behaviors at both the organizational and individual levels. Organizations then chose which activities they intended to implement in their organization and thus composed their own tailored integrated WHPP. The results from a one-year pilot study were promising and implementation of the program in practice was successful (16, 18, 19). Significant positive effects for smoking cessation and fruit

and vegetable intake were observed (19). In Andalusia, Spain, a similar program based on the LWHPN has also been successfully implemented (20). However, no significant changes in sweet consumption or PA were found after nine months, in this Spanish non-controlled study (21).

Currently, scientific evidence concerning the effectiveness of such integrated WHPPs is scarce. Therefore, we developed an integrated WHPP based on the LWHPN, tailored to the needs of employees and employers in the Netherlands (22). The aim of this study was to evaluate the effect of the developed integrated WHPP on the lifestyle of employees.

Methods

Study design and recruitment

Recruitment of organizations

The effectiveness of the integrated WHPP was evaluated in a two-armed cluster randomized controlled trial (C-RCT), with follow-up measurements at six and twelve months, which was conducted between January 2022 and March 2024. Four organizations in different occupational sectors (i.e. two educational organizations, an assurance, tax and consulting organization and a retail organization) participated in the C-RCT (Appendix 1). Within one of the educational organizations, only the ICT and facility departments participated. The participating organizations were recruited through the networks of the research team, coworkers and branch specific networks. Organizations were eligible for participation if they had at least 200 employees and had not yet implemented a WHPP similar to the WHPP under study, i.e. WHPPs with a focus on both the organizational and individual levels and/or activities within multiple health behaviors. The participating organizations implemented the integrated WHPP voluntarily, driven by their own interest in promoting healthy lifestyles at work, rather than out of a legal obligation within their occupational health and safety management.

The Medical Ethical Committee of VU University Medical Center (VUmc, Amsterdam, the Netherlands) approved the study protocol (2021.0402). The trial is registered in the Dutch Trial Register (LTR) under the number NL9526. Details on the development, sample size calculation, methods and outcome measures have been described in a protocol paper (22). We adhered to the CONSORT checklist for reporting our data analysis procedures (23).

Recruitment of participants

Employees within the participating organizations were informed about the study through different communication channels (e.g., e-mails, flyers, newsletters, and/or online communication apps, such as Microsoft Teams, and/or internal websites). Subsequently, employees were invited for an information session at the workplace or online to provide more detailed information about the study. Additionally, the employer emphasized the importance of this study and encouraged employees to participate. A QR code was placed on all recruitment materials and distributed during the online information sessions. Those interested in participating in this study received an information letter, eligibility checklist and informed consent at home by post.

The inclusion criteria for participants were: working for the participating organization for 12 or more hours per week, and an employment contract that either lasted until the final measurement or was to be extended to it. The exclusion criteria were: being on sick leave for more than four weeks or being pregnant. **Figure 1** shows the flow of participants throughout the trial.

At the time of recruitment approximately 1400 workers were employed within 17 clusters of the four participating organizations. Among these employees, information about the study was disseminated by the employer. In total, 180 of the employees who responded to the call and were willing to participate, were eligible for inclusion in the current study. Others were either excluded or did not return a signed informed consent. Approximately 1200 employees did not respond to the call for participation. This resulted in a response rate of 12.9%.

The baseline questionnaire was completed by 173 participants. The six-month follow-up questionnaire was sent to 171 participants, as two participants dropped out prior to the second measurement. The questionnaire was completed by 148 participants (86% of the baseline participants). A total of 163 participants received the twelve-month follow-up questionnaire, due to eight dropouts between the six- and twelve-month follow-up measurements. The questionnaire was completed by 131 participants (76% of the baseline participants). All participants who completed at least one follow-up questionnaire were included in the longitudinal analysis (n = 153).

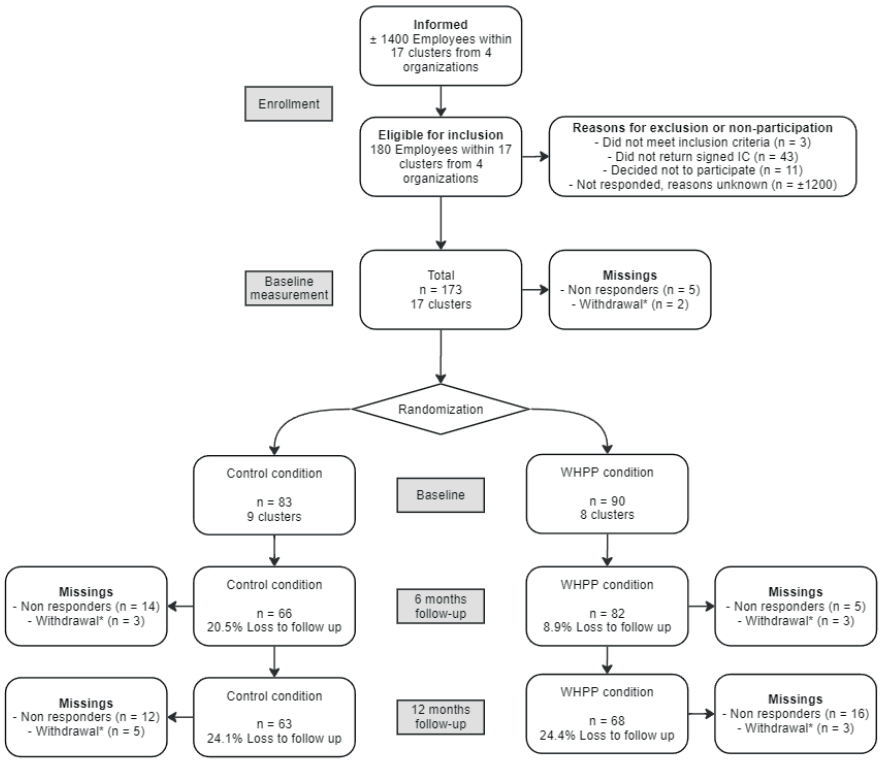

Fig. 1 Flowchart inclusion and (non-)response for the different measurements.

**Not able (e.g. left the organization, personal circumstances) or not willing to continue participation in the study. Loss to follow-up for each condition was calculated as the percentage relative to the total number of participants who completed the baseline questionnaire within the corresponding condition. Nonresponders at six months of follow-up did receive the questionnaire after twelve months of follow-up.*

Randomization, blinding, and sample size calculation

Block randomization was carried out by two independent researchers at the cluster level after the baseline measurement using a computer program, in which one of the independent researchers applied varying block sizes (24). Clusters were composed based on working locations, as an attempt to reduce contamination between the control and intervention conditions. Clusters in the intervention condition were instructed to implement the integrated WHPP within six months after randomization. Clusters in the control condition were placed on a waiting list and could implement the intervention after twelve months of follow-up. The researcher involved in data processing and analyses was blinded to group allocation. In the proposed study, 264 employees were necessary at twelve months of follow-up to obtain a power of 80% to statistically demonstrate a 10% lifestyle improvement, as measured by the Simple Lifestyle Indicator Questionnaire.

The intervention

The integrated WHPP consisted of a catalogue of health promoting activities and an implementation plan that assisted in successfully implementing the health promoting activities according to the criteria of the integrated WHPP.

Catalogue

The catalogue included evidence- and/or practice-based health promoting activities for six health behaviors at both the individual and organizational levels, including activities for employees working from home. The catalogue was based on the CHRODIS+ toolkit (25). The health behaviors included were: physical activity, nutrition, mental balance (stress, work-home balance, relaxation), smoking, alcohol consumption, and sleep. Examples of activities include exercise activities, healthy nutrition in the company restaurant, active work stations or stress management courses (Appendix 2). The individual level comprises two domains: 1) screening and support, which focuses on the identification of lifestyle-related issues and support in addressing these issues, and 2) information and education, in which stimulating awareness about the importance of a healthy lifestyle was key. The organizational level was also subdivided into two domains: 3) adjustments in the social, digital or physical work environment to support a healthy lifestyle and 4) policy adjustments to facilitate and encourage a healthy lifestyle. To meet the criteria of the integrated WHPP, activities had to be implemented on at least two different health behaviors and on both the individual and organizational levels for each health behavior.

Implementation plan

The implementation plan provided a step-by-step plan, which was developed based on barriers to and facilitators of the participation in and implementation of WHPPs according to employees and employers, respectively (14, 26). A working group consisting of HR professionals, employees and supervisors was composed within each organization. This working group was responsible for a needs assessment and the selection and implementation of activities. The contact person within each organization (often an HR professional or someone involved in WHP) composed the working group by either an open call for employees and supervisors to apply or by personally approaching colleagues.

Outcome measures

The participants received an online questionnaire at baseline and at six and twelve months of follow-up. All outcome measures pertain to the individual participant.

Primary outcome

The primary outcome was the overall lifestyle of employees, which was measured via the validated Simple Lifestyle Indicator Questionnaire (SLIQ) (22, 27, 28). The SLIQ provides a global lifestyle score and consists of five components: nutrition (3 questions), physical activity (3 questions), alcohol consumption (3 questions), smoking status (2 questions), and stress (1 question). For each lifestyle component in the SLIQ, a score of 0-2 was assigned yielding a total score of 0-10 for the overall lifestyle score, where 0 represents the most unhealthy lifestyle and 10 represents the healthiest lifestyle possible.

Secondary outcomes

The secondary outcome measures involved the separate health behaviors included in the catalogue of the integrated approach, i.e. physical activity, nutrition (sugary drinks and snacks), mental balance (stress, work-home balance and need for recovery), sleep (quality and quantity), smoking and alcohol consumption. All health behaviors were considered as it was not known beforehand which health behaviors would be targeted by the organizations.

Physical activity was measured using the validated Short QUestionnaire to ASsess Health-enhancing physical activity (SQUASH) (29). The SQUASH questionnaire measures the amount of time spent, during a regular week in the past month, in four different physical activity domains: commuting, occupational, household, and leisure time. The outcome measures included in the current study were: minutes of light physical activity (LPA), moderate physical activity (MPA) and vigorous physical activity (VPA) per week; these measures encompass time spent in all four physical activity domains.

For *nutrition*, questions referred to the consumption of sugary drinks and small and large snacks, both sweet, savory and deep-fried per week, during a regular month (30). With respect to the consumption of sugary drinks, questions were answered on a five-point scale (i.e., < 1, 1-6, 7-13, 14-20 and ≥ 21 sugary drinks per week). This variable was dichotomized (i.e., <1 vs ≥ sugary drinks per week) by merging the four highest categories, as the number of participants in these categories was low. Questions about five types of snacks, i.e., large and small sweet snacks, large and small savory snacks and fried snacks, were answered on a six-point scale (i.e. <1, 1, 2-3, 4-6 snacks per week, 1 per day and ≥ 2 per day). For the analysis, the five variables for snacks were combined into two variables, i.e., large snacks and small snacks, each with three categories. This process was performed in three steps. First, the categories were converted to the same unit, namely, the number of snacks

per week (i.e., 0, 1, 3, 5, 7 or 14 snacks per week). Second, the values for large savory, large sweet and fried snacks were summed, as were the values for small savory and small sweet snacks. Resulting in two continuous snack variables, i.e., large snacks and small snacks. Third, tertiles were generated based on baseline values of the large (0-2, 2-4 and 4-13) and small (0-4, 4-6 and6-28) snacks, which were then used to establish three categories for each variable for the statistical analysis.

With regard to *mental balance*, data about stress, work-life balance and need for recovery were collected. A subscale of the short version of the Depression Anxiety and Stress Scale (DASS-21) was used (31). This included seven statements to assess overall stress during the past week. The answers were summed to a total score ranging from 0 to 21 and then converted into five categories: normal, mild, moderate, severe and extremely severe stress. Due to low number of participants in the latter three categories, they were merged into one category, i.e., moderate to severe stress. The short version of the negative work-home interference scale of the Survey Work-home Interference Nijmegen (SWING) was used to measure work-life balance (32, 33). The extent to which work-life negatively interferes with home-life was assessed based on four items with a four-point scale. The scores of the four items were summed and averaged, leading to an overall score ranging from 0 to 3, in which 3 is the most negative work-home interference possible. A subscale of the Questionnaire on the Experience and Evaluation of Work was used to measure the need for recovery (34, 35). This scale consists of eleven statements that had to be answered as either yes or no. A score of 0 was assigned to the positive answer and 1 to the negative answer. The sum of the items was then standardized to a score ranging between 0 and 100, in which a score of 100 was the highest need for recovery. All the questionnaires were found to be valid and reliable (31, 33, 34, 36).

Sleep quality and quantity in the past four weeks as perceived by the participants were assessed using the validated Medical Outcomes Study Sleep scale (MOS-SS) (37). Sleep quality comprised sleep disturbance and somnolence and were measured with four and three items, respectively. These items were scored on a six-point scale and converted to a score between 0 and 100. A higher score indicated greater perceived sleep disturbance or greater somnolence. Sleep quantity was assessed by the average hours of sleep per night in the past four weeks.

Smoking status, yes or no, was assessed by the first question regarding smoking included in the SLIQ, i.e., are you a smoker? Similarly, questions regarding *alcohol consumption* included in the SLIQ were used to calculate the total consumption

of alcoholic beverages during an average week. To do so, the average number of beers, wine and spirits consumed in one week were summed.

Covariates

Data about sex, age, educational level, self-reported chronic diseases, self-perceived health, measured using the RAND-36, physical job intensity and working situation i.e., working from home or at the workplace fulltime or parttime, were collected at baseline (38).

Statistical analysis

Descriptive analyses were conducted for both conditions separately and for the total study population. All analyses were performed according to the intention-to-treat principle; thus, effect outcomes were evaluated regardless of whether organizations met the criteria of the integrated WHPP and regardless of the participation levels of employees.

For the analysis of the primary outcome measure over time and at six and twelve months of follow-up, a linear multilevel analysis with three identified levels (working locations, i.e. the clusters, participants and time) was performed. To assess the effect of the integrated WHPP at six and twelve months, an interaction term for time and condition was added. First, an analysis adjusted for the baseline value of the outcome measure (model 1) was performed to evaluate the differences between the control and intervention conditions over time and at six and twelve months of follow-up. Second, the abovementioned analyses were performed and additionally adjusted for demographic factors (age, sex and educational level) and self-perceived health measured at baseline (model 2). Effect modification was considered for working situation (working from home or at the workplace, fulltime or parttime) measured at baseline, and a p-value <0.1 of the interaction term was used to indicate effect modification.

Analyses of secondary continuous outcomes, i.e. physical activity, need for recovery, work-home balance, alcohol consumption and sleep, were identical. The categorical secondary outcome measures, i.e. snacks (large and small) and stress were analyzed using an ordinal logistic multilevel analysis. Dichotomous outcomes, namely, the consumption of sugary drinks and smoking, were analyzed by conducting a generalized estimating equation (GEE) which was adjusted for the clustering of repeated measures. An additional adjustment for organization was included. The analyses for secondary outcome measures followed the same procedure as mentioned above. To assess differences between drop-outs and

participants, t-tests and Fisher tests were conducted; additionally, a Bonferroni correction was performed to account for multiple comparisons. All statistical analyses were performed using Rstudio version 2023.03.1 (lme4, geepack and ordinal packages) (39-42).

Results

Demographics

Slightly more than half of the participants (52.6%) were female (Table 1). The mean age of the participants was 43.3 years (SD = 11.9), and 66.7% had a high educational level. More than one third (38.7%) of the participants had one or more self-reported physical or mental health problem(s). A low level of physical load at work was reported by 79.8% of the participants. The average number of working hours per week was 35.7 hours (SD = 7.6), and 39.9% worked only at the workplace and not from home.

Table 1. Baseline characteristics of participants in the control condition, intervention condition and total study population.

Characteristics	Control condition (n=83)	Intervention condition (n=90)	Total (n=173)
Sex, female, n(%)	39 (47.0)	52 (57.8)	91 (52.6)
Age, mean (SD), years	44.7 (11.2)	42.5 (11.6)	43.6 (11.5)
Educational level, n(%)			
Lower education	3 (3.6)	6 (6.7)	9 (5.2)
Moderate education	24 (28.9)	24 (26.7)	48 (27.7)
Higher education	56 (67.5)	60 (66.7)	116 (67.1)
One or more chronic diseases[a], n(%)	36 (43.4)	31 (34.4)	67 (38.7)
Work			
Working hours per week, mean (SD)	35.6 (7.1)	35.9 (8.0)	35.7 (7.6)
Job intensity, n(%)[b]			
Low physical load	60 (72.3)	78 (86.7)	138 (79.8)
Light physical load	22 (26.5)	7 (7.8)	29 (16.7)
Moderate physical load	1 (1.2)	5 (5.5)	6 (3.5)
Working from home, n(%)			
Never	38 (45.8)	31 (34.4)	69 (39.9)
Parttime	43 (51.8)	56 (62.2)	99 (57.2)
Fulltime	2 (2.4)	3 (3.3)	5 (2.9)

[a]Self-reported physical or mental health problems. [b]Low physical load: A sedentary occupation. Light physical load: A standing occupation, including walking but not high intensity physical activity. Moderate physical load: An occupation that included occasional heavy lifting.

Table 2 reports the baseline values of the outcome measures. The mean lifestyle scores at baseline were 7.0 (SD = 1.5) and 7.2 (SD = 1.5), on a scale from 0 to 10 for the control and intervention conditions, respectively. Drop-out analyses did not reveal differences between the drop-outs and participants (Appendix 3 and 4).

Effect of the intervention

Table 3 shows the estimated effect sizes of the intervention on the primary and secondary outcome measures over time and at six and twelve months of follow-up. There was no effect modification of the working situation.

Table 2. Means and frequencies for the primary and secondary outcome variables at baseline and at six and twelve months of follow-up.

	Baseline		**Six months follow-up**		**Twelve months follow-up**	
	C *(n=83)*	**I** *(n=90)*	**C** *(n=66)*	**I** *(n=81)*	**C** *(n=63)*[a]	**I** *(n=68)*[b]
Overall lifestyle, mean (SD)	7.0 (1.5)	7.2 (1.5)	7.2 (1.5)	7.1 (1.5)	7.1 (1.5)	7.2 (1.4)
Physical activity						
LPA, minutes per week, mean (SD)	2225.1 (1025.8)	2502.4 (834.0)	2176.0 (947.9)	2378.8 (1089.6)	2243.6 (895.1)	2244.4 (1034.6)
MPA, minutes per week, mean (SD)	589.2 (538.5)	445.8 (549.7)	602.1 (477.7)	422.1 (374.2)	663.0 (557.0)	510.0 (479.9)
VPA, minutes per week, mean (SD)	123.4 (158.2)	86.9 (127.9)	121.2 (138.5)	92.0 (131.0)	124.5 (171.2)	76.9 (114.7)
Nutrition						
Sugary drinks per week, n(%)						
<1 per week	39 (47.0)	47 (52.2)	33 (50.0)	39 (48.1)	32 (52.5)	32 (47.1)
≥1 per week	44 (53.0)	43 (47.8)	33 (50.0)	42 (51.9)	29 (47.5)	36 (52.9)
Large snacks[c] per week, n(%)						
0-2 per week	32 (38.6)	44 (48.9)	25 (37.9)	33 (40.7)	25 (41.0)	27 (40.7)
2-4 per week	29 (34.9)	21 (23.3)	23 (34.8)	31 (38.3)	21 (34.4)	23 (33.8)
4-13 per week	22 (26.5)	25 (27.8)	18 (27.3)	17 (21.0)	15 (24.6)	18 (26.5)
Small snacks[d] per week, n(%)						
0-4 *per week*	35 (42.2)	34 (37.8)	28 (42.4)	36 (44.4)	27 (44.3)	30 (44.1)
4-6 *per week*	19 (22.9)	28 (31.1)	21 (31.8)	20 (24.7)	14 (23.0)	17 (25.0)
6-28 *per week*	29 (34.9)	28 (31.1)	17 (25.8)	25 (30.9)	20 (32.8)	21 (30.9)

Table 2. Continued

	Baseline		**Six months follow-up**		**Twelve months follow-up**	
	C *(n=83)*	**I** *(n=90)*	**C** *(n=66)*	**I** *(n=81)*	**C** *(n=63)*[a]	**I** *(n=68)*[b]
Mental balance						
Perceived stress, n(%)						
Normal	62 (74.7)	65 (72.2)	56 (84.8)	59 (72.8)	51 (83.6)	48 (71.6)
Mild	13 (15.7)	12 (13.3)	6 (9.1)	12 (14.8)	6 (9.8)	11 (16.4)
Moderate to severe	8 (9.6)	13 (14.5)	4 (6.1)	10 (12.4)	4 (6.6)	8 (12.0)
NFR, mean (SD)	30.4 (30.4)	38.2 (31.8)	28.5 (29.6)	33.6 (30.4)	27.6 (28.3)	37.4 (31.4)
Work-life balance, mean (SD)	0.8 (0.6)	0.8 (0.6)	0.8 (0.6)	0.8 (0.5)	0.8 (0.5)	0.7 (0.6)
Sleep						
Sleep disturbance, mean (SD)	25.0 (14.3)	30.7 (19.9)	26.9 (15.4)	30.5 (18.1)	25.8 (14.1)	31.8 (19.9)
Somnolence, mean (SD)	21.8 (15.6)	22.0 (14.4)	23.1 (16.2)	25.1 (15.0)	23.3 (16.3)	22.6 (14.4)
Hours of sleep per night, mean (SD)	7.3 (0.8)	6.9 (1.0)	7.0 (0.9)	6.8 (1.2)	7.1 (0.8)	6.8 (1.2)
Smoking						
Smoking status, yes, n(%)	12 (14.5)	1 (1.1)	9 (13.6)	3 (3.7)	7 (11.1)	1 (1.5)
Alcohol						
Alcohol consumption per week, mean (SD)	4.3 (4.7)	4.1 (4.9)	5.4 (5.9)	5.5 (6.2)	3.6 (4.3)	3.8 (4.5)

Abbreviations: C = Control condition, I = Intervention condition, LPA = Light Physical Activity, MPA = Moderate Physical Activity, VPA = Vigorous Physical Activity, NFR = Need for recovery. [a] N = 2 participants did not fully complete the questionnaire. [b] N = 1 participant did not fully complete the questionnaire. [c] Large snacks: sweet, savory and fried. [d] Small snacks: sweet and savory.

Table 3. Effect estimates based on model 2 for the primary and secondary outcomes of the WHPP intervention over time and after six and twelve months of follow-up.

	6 months	**12 months**	**6-12 months**
	β *(CI)*	**β *(CI)***	**β *(CI)***
Overall lifestyle	-0.2 (-0.5 – 0.2)	-0.1 (-0.5 – 0.3)	-0.1 (-0.5 – 0.2)
Physical activity	**β *(CI)***	**β *(CI)***	**β *(CI)***
LPA minutes per week	147.8 (-156.3 – 453.6)	-62.5 (-381.6 – 259.8)	53.3 (-195.1 – 303.6)
MPA minutes per week	-140.8 (-310.2 – 29.0)	-107.8 (-282.7 – 67.6)	-129.5 (-284.9 – 26.6)
VPA minutes per week	-0.1 (-36.6 – 35.7)	-22.2 (-59.9 – 14.9)	-9.9 (-43.6 – 22.6)
Nutrition	**OR *(CI)***	**OR *(CI)***	**OR *(CI)***
Sugary drinks	2.0 (0.6 – 6.4)	2.9 (1.03 – 8.0)*	2.4 (1.1 – 5.4)*
Large snacks[a]	0.7 (0.3 – 1.8)	1.0 (0.4 – 2.9)	1.0 (0.5 – 2.3)
Small snacks[b]	0.9 (0.3 – 3.0)	0.8 (0.2 – 2.6)	1.0 (0.4 – 2.7)
Mental balance	**OR/β *(CI)***	**OR/β *(CI)***	**OR/β *(CI)***
Stress (OR)	3.3 (0.9 – 12.2)	2.8 (0.7 – 10.8)	3.0 (1.0 – 9.5)
Need for recovery (β)	1.2 (-6.8 – 9.3)	3.9 (-4.4 – 12.3)	2.3 (-5.2 – 9.9)
Work-life balance (β)	-0.1 (-0.3 – 0.1)	-0.1 (-0.2 – 0.1)	-0.1 (-0.2 – 0.1)
Sleep	**β *(CI)***	**β *(CI)***	**β *(CI)***
Sleep disturbance	0.3 (-3.4 – 4.0)	1.8 (-2.1 – 5.8)	1.0 (-2.3 – 4.2)
Sleep somnolence	3.0 (-0.3 – 6.2)	-1.3 (-4.8 – 2.3)	1.1 (-1.8 – 4.0)
Sleep quantity	-0.2 (-0.6 – 0.2)	-0.3 (-0.7 – 0.1)	-0.3 (-0.7 – 0.1)
Alcohol consumption	**β *(CI)***	**β *(CI)***	**β *(CI)***
Consumptions per week	0.1 (-1 – 1.1)	0.3 (-0.8 – 1.4)	0.2 (-0.7 – 1.1)

Effect estimates based on model 2, adjusted for baseline values of the outcome measure, age, sex, education and perceived health at baseline, were reported. Abbreviations: β = Beta (regression coefficient), OR = Odds ratio, CI = 95%, LPA = Light Physical Activity, MPA = Moderate Physical Activity, VPA = Vigorous Physical Activity, NFR = Need for recovery. *Statistically significant difference. [a] Large snacks: sweet, savory and fried. [b] Small snacks: sweet and savory. Smoking status was not included in the analysis, as none of the models converged.

No statistically significant differences were found in the overall lifestyle of employees between the intervention and control conditions over time or at six months and twelve months of follow-up.

With the exception of the consumption of sugary drinks, there were also no intervention effects on any of the secondary outcomes. It appeared that over time and at twelve months of follow-up participants in the intervention condition had 2.4 (95%CI: 1.1 – 5.4) and 2.9 (95%CI: 1.03 – 8.0) higher odds of consuming ≥1 sugary drink per week, respectively, compared to participants in the control condition.

Discussion

The current study revealed no effects of the integrated WHPP on the overall lifestyle score. With respect to secondary outcomes, a greater consumption of sugary drinks in the intervention condition over time and at twelve months of follow-up was observed, compared to the control condition.

An important limitation of the current study is that the a priori calculated sample size was not met. The recruitment and start of the intervention study took place during the COVID-19 pandemic, which hindered the recruitment of organizations and participants. Moreover, many organizations could not participate due to a lack of time, other priorities or unfavorable timing. As a result, only 173 employees participated in this study at baseline, instead of the calculated 264 employees. However, the very low effect size for the primary outcome measure after twelve months (-0.1) might suggest that, possibly due to inadequate implementation in this study, the integrated WHPP would not yield an effect with a larger sample size. Nevertheless, to some extent the limited statistical power of the study might have contributed to the lack of effect of the integrated WHPP.

Two key elements of the integrated WHPP were: 1) the implementation of activities at both the individual and organizational levels for multiple lifestyle themes and 2) the selection and implementation of activities that fit the organization and the needs of employees by a working group, consisting of HR, supervisors and employees (43). However, based on the results of the process evaluation, it appeared that in particular the implementation of the first key element did not succeed as intended in practice. All the organizations implemented activities targeting at least two different health behaviors, but the activities were not on both the individual and organizational level, indicating that the criteria of the integrated WHPP were not met (43). Consequently, we cannot assess the true effect of the integrated WHPP as intended; rather, we examined the effect of the 'integrated WHPP as implemented by the organizations'. The fact that the integrated WHPP was not implemented as intended might partially explain the absence of an effect on the primary outcome, i.e., overall lifestyle. As it was unclear beforehand which health behaviors from the catalogue the organizations would target, secondary outcome measures were included for each of the health behaviors in the catalogue. Eventually, two organizations mainly targeted physical activity, one organization nutrition and one organization mental balance. Therefore, an effect for the non-targeted health behaviors was not expected. Although not all organizations targeted for instance, physical activity, all organizations were included in the analysis of that health

behavior. This might mitigate the potential effect, which implies the need to further investigate the specific effects on the targeted health behaviors.

Three factors related to the implemented activities are potentially attributed to the absence of effects in our study. First, the implementation of simple and minimal activities or adjustments, such as nudges to take the stairs or information messages at an internal website. Second, the low frequency and irregular occurrence of activities, for instance exercise workshops or a one-time tasting event. And third, the short exposure of employees to the activities, as most activities were implemented shortly before the six-month follow-up measurement. The choice for minimal and easy to implement activities was also observed in a study of a comparable WHPP, in which project leaders selected evidence-based activities from a list based on a needs assessment among employees (44). Most of the implemented activities in the study of Wierenga et al. (2014) did not require active participation of employees, but included, for instance, free fruit at the workplace or posters. The researchers stated that low costs and low implementation effort were prioritized over effectiveness when selecting suitable activities. These minimal activities are positive initial steps, which might create awareness rather than actual behavior change, as behavior change requires a more intensive approach (5, 44, 45). To promote healthy habits, repetition of the desired behavior in a stable context is an important component (45, 46). For instance, Kaushal and Rhodes (2015) indicated that to adopt new, healthy physical exercise habits, approximately six weeks of regular exercise work outs were required (47). The importance of activities with high frequency and regularity has also been highlighted in other studies (5, 12). Wierenga et al. (2013) reported that activities that occurred once per week were four times more effective in improving nutrition and physical activity health behaviors than activities with a lower weekly frequency (5). Nöhammer et al. (2010) reported that the regularity of activities could enhance effectiveness (12). In our study, the short exposure of employees to the activities is a result of the extensive time required for establishing the working group, consequently causing a delay in the implementation of activities. If the amount of time between activities is too long, it might affect the enthusiasm to participate (44). Thus, the delay in implementation might have affected participation in activities, which in turn can negatively impact effectiveness (48, 49). To increase effectiveness, extensive activities taking place regularly without delays between separate activities are required. As costs and implementation efforts were important considerations for organizations when selecting activities, it is essential to find a middle ground between activities that are both effective, low-cost and low-effort (44). Organizations need to have a clear understanding of which activities meet these requirements. The responsibility for

implementing more extensive activities is thus shared. While organizations should not only focus on simple activities, they also require additional support to make the right choice. For instance, information about the activities regarding effectiveness, costs and implementation efforts should be explicitly outlined in the catalogue in future studies.

As to the secondary outcomes, our findings are in contrast with results of a previous non-randomized controlled before-after evaluation of the effects of the Lombardy Workplace Health Promotion Network (LWHPN), where the intake of fruit and vegetables and smoking cessation increased significantly after twelve months (19). Based on a quasi-experimental controlled trial, days of fruit consumption also increased in a study conducted by Wierenga et al. (2014), but no effect was observed for pieces of fruit consumed and physical activity outcome measures (44). In line with our study, both the LWHPN and the study of Wierenga et al. organizations composed a working group including employees that was instructed to implement activities from a list or catalogue. A difference between our study and the one by Wierenga et al., was that a project leader was appointed, who could allocate 16 hours per week to the implementation of activities (44). Additionally, an external advisor was available, to support implementation. However, an even more active role of this advisor might be required, in assisting organizations to select activities that are both easy to implement and effective. Organizations in the LWHPN received support from the Lombardy Region to which they had to report back to the about the implementation process and planning. This might positively attribute to successful implementation and consequently, the effectiveness of the LWHPN, as a concrete implementation plan has to be developed each year (18). In our study, organizations received minimal implementation support as the researchers occupied an observational role to assess the ability of organizations to implement the integrated WHPP independently. In line with Wierenga et al., this approach appeared to be challenging, and in addition to guidance regarding the selection of activities, more extensive implementation support might be required in future research. Moreover, to enhance feasibility of implementation for organizations, it could be considered to spread out implementation by focusing on different health behaviors each year while maintaining existing activities. This is also consistent with the LWHPN, where organizations can receive a vignette upon implementing new activities that target different health behaviors annually while retaining existing activities (18).

With regard to the consumption of sugary drinks, surprisingly, participants in the intervention condition were more than two times more likely to consume more

than one sugary drink per week over time, compared to the control condition. At each measurement moment, the percentage of employees in both conditions who consumed more than one sugary drink was approximately 50%. Indicating that still a large percentage consumed less than one sugary drink per week. Moreover, the four categories with the highest number of sugary drinks had to be merged because of the low number of participants in these categories. This implies that, overall, the consumption of sugary drinks among the participants was low. Thus leaving little room for improvement due to a ceiling effect. The consumption of sugary drinks was targeted by one organization, which replaced sodas with healthy syrups. It is plausible that employees also considered these healthy syrups to be sugary drinks and thus reported them as such in the questionnaires. If employees started consuming these healthy syrups instead of for instance water, this could have contributed to the observed difference in consumption of sugary drinks in favor of the control condition. Another factor to consider is the relatively high lifestyle score at baseline in this study population, with a mean of 7.1 on a scale from 0 to 10. Additionally, the response rate of only 12.9% suggests a potential selection bias. As reported by other studies, it is likely that employees who are already interested in health promotion or who are more health-conscious are more inclined to participate (50, 51). The effectiveness of the integrated WHPP, as implemented by the participating organizations, might be affected by this, i.e., the relatively high lifestyle score at baseline and selection bias. As employees who are health-conscious may have already integrated these healthy behaviors into their lifestyle, independent of the integrated WHPP (50).

The study design, a C-RCT, mitigates the risk of contamination between the intervention and control conditions, which can be seen as a strength of the study. Nevertheless, as employees sometimes work from multiple locations, it is impossible to completely avoid contamination. Hence, not all activities were exclusively accessible for participants in the intervention condition; in some cases, participants in the control condition could also participate in implemented activities. As exact data about which employees work at multiple locations are lacking, the extent to which this affects the results cannot be estimated.

Conclusions

Based on the current study, it can be concluded that the integrated WHPP, as implemented by the participating organizations, was not effective. Neither in improving the overall lifestyle nor separate health behaviors of employees. The brief exposure of employees to activities, the implementation of simple and minor activities and adaptations only, not meeting the criteria of the integrated WHPP, and

the high baseline scores for overall lifestyle should be considered when interpreting the results. Future studies including more time to implement the integrated WHPP and a focus on continuity and more substantial activities with a higher frequency are recommended.

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Appendices

Appendix 1

A1. Characteristics of the participating organizations

Organization	Occupational sector	Number of employees	Locations
1	Educational organization	319[a]	2
2	Assurance, tax and consulting organization	639	7
3	Educational organization	197	4
4	Retail organization	256[a]	27[b]

[a] Number of employees in participating departments within the organization.
[b] Divided over four regional clusters.

Appendix 2

A2. Examples of activities included in the catalogue.

Health behavior	Individual level	Organizational level
Nutrition	Disseminate information about a healthy diet. For instance by videos made by employees or supervisors.	Adjustments to the company restaurant, such an increased variety of healthy selections and promoting only healthy products.
Physical activity	Provide employees with a logbook, pedometer, or activity tracker to monitor their goals.	Replace sitting desks with sit-stand desks. Make standing while working the norm (by keeping stand desks in the high position).
Mental balance	Provide individual or group sessions focused on stress management.	Create a designated area for silence.
Sleep	Provide workshops aimed at improving sleep.	Offer the opportunity for flexible and remote work, allowing employees to tailor their own work hours.
Smoking	Provide support for smoking cessation, such as referral to or advice from a professional, or access to a course or app.	Provide reimbursement for nicotine replacement products.
Alcohol	Provide support reducing excessive alcohol consumption, including referrals to or guidance from professionals, as well as access to courses or apps.	Organize alcohol-free social events, providing a range of 0.0% alternatives to alcoholic beverages.

Appendix 3

A3. Drop-out analyses after six months of follow-up, baseline values and p-values of descriptive and outcome measures for control condition and intervention condition.

Variable	Control condition		
	Mean/n(%) participants	Mean/n(%) dropouts	p-value
Sex (female)[a]	34 (51.5%)	5 (29.4%)	0.17
Age, years[b]	43.7	48.8	0.08
Educational level[a]			0.13
Lower education	3 (4.6%)	0 (0.0%)	
Moderate education	22 (33.3%)	2 (11.8%)	
Higher education	41 (62.1%	15 (88.2%)	
One or more chronic diseases[a, c, d]	25 (37.9%)	11 (64.7%)	0.06
Working hours per week[b, c]	35.7	35.5	0.94
Job intensity[a, c, e]			0.50
Low physical load	49 (74.3%)	11 (64.7%)	
Light physical load	16 (24.2%	6 (35.3%)	
Moderate physical load	1 (1.5%)	0 (0.0%)	
Working from home[a]			0.86
Fulltime	2 (3.0%)	0 (0.0%)	
Parttime	33 (50,0%)	10 (58.8%)	
Never	31 (47.0%)	7 (41.2%)	
Overall lifestyle[b]	6.9	7.4	0.34
LPA, minutes per week[b]	2347.1	1751.5	0.04
MPA, minutes per week[b]	569.4	665.8	0.52
VPA, minutes per week[b]	136.2	74.1	0.09
≥1 Sugary drinks per week[a]	35 (53.0%)	9 (52.9%)	1.0
Large snacks per week[a, f]			0.43
0-2 per week	23 (34.8%)	9 (52.9%)	
2-4 per week	24 (36.4%)	5 (29.4)	
4-13 per week	19 (28.8%)	3 (17.7%)	
Small snacks per week[a, g]			0.94
0-4 per week	27 (40.9%)	8 (47.1%)	
4-6 per week	16 (24.2%)	3 (17.6%)	
6-28 per week	23 (34.9%)	6 (35.3%)	
Perceived stress[a]			0.12
Normal	51 (77.3%)	11 (64.7%)	
Mild	11 (16.7%)	2 (11.8%)	

	Intervention condition		
	Mean/n(%) participants	**Mean/n(%) dropouts**	**p-value**
	48 (58.5%)	4 (50%)	0.72
	43.3	34.1	0.02
			0.68
	6 (7.3%)	0 (0.0%)	
	23 (28.1%)	1 (12.5%)	
	53 (64.6%)	7 (87.5%0	
	25 (30.5%)	6 (75%)	0.02
	35.7	37.9	0.23
			1.0
	70 (85.4%)	8 (100%)	
	7 (8.5%)	0 (0.0%)	
	5 (6.1%)	0 (0.0%)	
			1.0
	3 (3.7%)	0 (0.0%)	
	51 (62.2%)	5 (62.5%)	
	28 (34.1%)	3 (37.5%)	
	7.2	8.0	0.12
	2479.0	2741.9	0.08
	462.6	273.1	0.06
	84.6	110.6	0.58
	39 (47.6%)	4 (50%)	1.0
			0.80
	40 (48.8%)	4 (50.0%)	
	20 (24.4%)	1 (12.5%)	
	22 (26.8%)	3 (37.5%)	
			0.53
	30 (36.6%)	4 (50.0%)	
	25 (30.5%)	3 (37.5%)	
	27 (32.9%)	1 (12.5%)	
			0.05
	62 (75.6%)	3 (37.5%)	
	10 (12.2%)	2 (25.0%)	

A3. Continued

Variable	Control condition		
	Mean/n(%) participants	**Mean/n(%) dropouts**	**p-value**
Moderate to severe	4 (6.0%)	4 (23.5%)	
NFR[b]	29.6	33.7	0.66
Work-life balance[b]	0.8	1.0	0.11
Sleep disturbance[b]	25.6	22.8	0.45
Sleep somnolence[b]	22.4	19.6	0.44
Hours of sleep per night[b]	7.3	7.2	0.89
Smoking status (yes)[a]	10 (15.2%)	2 (11.8%)	1.0
Alcohol consumption per week[b]	4.3	4.3	1.0

A significance level of $p < 0.002$ with Bonferroni correction was applied to account for multiple comparisons. Abbreviations: LPA = Low physical activity, MPA = Moderate physical activity, VPA = Vigorous physical activity, NFR = Need for recovery.*indicates a significant difference between drop-outs and participants. [a] Fisher test was conducted to assess differences between participants and drop-outs. [b] t-test was conducted to assess differences between participants and drop-outs. [c] variable was not included in the analyses. [d] Self-reported physical or mental health problems. [e] Low physical load: A sedentary occupation. Light physical load: A standing occupation, including walking but no high intensity physical activity. Moderate physical load: An occupation that included occasional heavy lifting. [f] Large snacks: sweet, savory and fried. [g] Small snacks: Sweet and savory.

	Intervention condition		
	Mean/n(%) participants	**Mean/n(%) dropouts**	**p-value**
	10 (12.2%)	3 (37.5%)	
	34.7	73.9	0.008
	0.8	1.3	0.19
	29.9	38.8	0.36
	21.4	28.3	0.23
	6.9	7.0	0.64
	1 (1.2%)	0 (0%)	1.0
	4.2	2.9	0.28

Appendix 4

A4. Drop-out analyses after twelve months of follow-up, baseline values and p-values of descriptive and outcome measures for control condition and intervention condition

Variable	Control condition		
	Mean/n participants	Mean/n dropouts	p-value
Sex, (female)[a]	28 (44.4%)	11 (55.0%)	0.45
Age, years[b]	45.1	43.4	0.58
Educational level[a]			0.42
Lower education	3 (4.8%)	0 (0.0%)	
Moderate education	20 (31.7%)	4 (20.0%)	
Higher education	40 (63.5%)	16 (80.0%)	
One or more chronic diseases[a, c, d]	26 (41.3%)	10 (50.0%)	0.61
Working hours per week[b, c]	35.5	36.2	0.69
Job intensity[a, c, e]			0.36
Low physical load	46 (73.0%)	14 (70.0%)	
Light physical load	17 (27.0%)	5 (25.0%)	
Moderate physical load	0 (0.0%)	1 (5.0%)	
Working from home[a]			0.89
Fulltime	2 (3.2%)	0 (0.0%)	
Parttime	33 (52.4%)	10 (50.0%)	
Never	28 (44.4%)	10 (50.0%)	
Overall lifestyle[b]	7.0	7.2	0.54
LPA, minutes per week[b]	2375.2	1752.5	0.03
MPA, minutes per week[b]	531.4	771.2	0.19
VPA, minutes per week[b]	130.0	102.8	0.45
≥1 Sugary drinks per week[a]	26 (41.3%)	13 (65.0%)	0.08
Large snacks per week[a, f]			0.07
0-2 per week	21 (33.3%)	11 (55.0%)	
2-4 per week	26 (41.3%)	3 (15.0%)	
4-13 per week	16 (25.4%)	6 (30.0%)	
Small snacks per week[a, g]			0.49
0-4 per week	26 (41.3%)	9 (45.0%)	
4-6 per week	13 (20.6%)	6 (30.0%)	
6-28 per week	24 (38.1%)	5 (25.0%)	
Perceived stress[a]			0.46
Normal	49 (77.8%)	13 (65.0%)	
Mild	9 (14.3%)	4 (20.0%)	

	Intervention condition		
	Mean/n participants	**Mean/n dropouts**	**p-value**
	38 (55.9%)	14 (63.6%)	0.62
	42.6	42.4	0.94
			0.43
	6 (8.8%)	0 (0.0%)	
	17 (25.0%)	7 (31.8%)	
	45 (66.2%)	15 (68.2%)	
	20 (29.4%)	11 (50.0%)	0.12
	36.1	35.1	0.60
			0.87
	58 (85.3%)	20 (91.0%)	
	6 (8.8%)	1 (4.5%)	
	4 (5.9%)	1 (4.5%)	
			0.66
	3 (4.4%)	0 (0.0%)	
	43 (63.2%)	13 (59.1%)	
	22 (32.4%)	9 (40.9%)	
	7.3	7.0	0.58
	2495.7	2523.0	0.89
	430.8	492.0	0.73
	82.7	99.8	0.55
	33 (48.5%)	14 (63.6%)	0.23
			0.39
	33 (48.5%)	11 (50%)	
	18 (26.5%)	3 (13.6%)	
	17 (25.0%)	8 (36.4%)	
			0.27
	23 (33.8%)	11 (50.0%)	
	24 (35.3%)	4 (18.2%)	
	21 (30.9%)	7 (31.8%)	
			0.86
	50 (73.6%)	15 (68.2%)	
	9 (13.2%)	3 (13.6%)	

A4. Continued

Variable	Control condition		
	Mean/n participants	**Mean/n dropouts**	**p-value**
Moderate to severe	5 (7.9%)	3 (15.0%)	
NFR[b]	27.8	38.6	0.24
Work-life balance[b]	0.8	1.1	0.12
Sleep disturbance[b]	24.6	26.3	0.66
Sleep somnolence[b]	22.1	21.0	0.76
Hours of sleep per night[b]	7.2	7.3	0.73
Smoking status (yes)[a]	8 (12.7%)	4 (20.0%)	0.47
Alcohol consumption per week[a]	4.0	5.1	0.39

A significance level of $p < 0.002$ with Bonferroni correction was applied to account for multiple comparisons. Abbreviations: LPA = Low physical activity, MPA = Moderate physical activity, VPA = Vigorous physical activity, NFR = Need for recovery.*indicates a significant difference between drop-outs and participants. [a] Fisher test was conducted to assess differences between participants and drop-outs. [b] t-test was conducted to assess differences between participants and drop-outs. [c] variable was not included in the analyses. [d] Self-reported physical or mental health problems. [e] Low physical load: A sedentary occupation. Light physical load: A standing occupation, including walking but no high intensity physical activity. Moderate physical load: An occupation that included occasional heavy lifting. [f] Large snacks: sweet, savory and fried. [g] Small snacks: Sweet and savory.

	Intervention condition		
	Mean/n participants	**Mean/n dropouts**	**p-value**
	9 (13.2%)	4 (18.2%)	
	33.4	52.9	0.03
	0.8	1.0	0.18
	30.1	32.3	0.67
	21.4	23.9	0.47
	6.9	6.9	0.98
	1 (1.5%)	0 (0.0%)	1.0
	4.2	3.8	0.74

Chapter 7

The effect of an integrated workplace health promotion program on health behaviors targeted after 12 months: Results of a cluster randomized controlled trial

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Abstract

Introduction: An integrated workplace health promotion program (WHPP) targeting multiple health behaviors by implementing activities at the individual and organizational level is potentially effective. The aim of this study was to evaluate the effect of implemented activities on targeted health behaviors.

Methods: Data from four organizations in a cluster randomized controlled trial, including 173 employees, were used. Linear multilevel analyses or generalized estimating equations were conducted to assess within- and between-condition differences for physical activity (PA) and nutrition.

Results: No between-condition differences were apparent for both health behaviors. Within the PA intervention condition, moderate PA increased and light PA decreased. Within the control condition the odds to consume more sugary drinks was lower.

Conclusion: Implemented activities did not affect the targeted health behaviors, although moderate PA increased within the PA intervention condition. Small sample sizes and implementation of minimal, irregular activities may underly the absence of effect. Future research should address this.

Introduction

Workplace health promotion programs (WHPP) are often implemented to encourage healthy lifestyle choices among employees during working hours (1-3). Through improved health behaviors, WHPPs will potentially lead to individual health benefits and subsequently may yield benefits for the employer, e.g. by increased productivity and decreased sick leave (1, 4, 5). The effectiveness of various types of WHPPs on the health behavior targeted has been studied widely (3, 6-8). The majority of these WHPPs focused on the individual level. Examples of such interventions are cognitive behavioral therapy, problem solving training, counseling sessions regarding physical activity and nutrition or stress management sessions (6, 7). However, to promote a healthy lifestyle not only the individual level should be targeted. The organizational level i.e. the physical and social environment and policies, should also be included (2, 9, 10). As health behavior is affected by both conscious and nonconscious choices, WHPPs that focus on the individual and organizational level, influencing both the conscious and nonconscious choices, are thus promising (9, 10).

Hence, an integrated WHPP that targets both the individual and organizational level is potentially effective. An example of such an approach is the Lombardy WHP Network (LWHPN) (11). The LWHPN is recognized as a European Good Practice because of its integrated approach, its promising results from a pilot study and the successful implementation (12). A positive effect was observed for both smoking cessation and fruit and vegetable intake (13, 14). Building upon the LWHPN, the program was adapted and tailored to the Dutch context to take into account cultural differences between countries (15, 16). The developed Dutch integrated WHPP consisted of a catalogue with a varying range of activities that could be implemented by organizations on six different health behaviors, i.e. physical activity, nutrition, mental balance, sleep, smoking and alcohol, and an implementation plan. Organizations could thus compose their own tailored integrated WHPP, by implementing activities that fit their organization and the needs of their employees. As different health behaviors are often intertwined, and focusing on a combination of different themes might yield more effect, the integrated WHPP aimed to target multiple health behaviors simultaneously (8, 17, 18). Considering the different health behaviors selected by each organization, it is plausible to expect an effect on the specific health behaviors that have been targeted as part of the integrated WHPP. Hence, the aim of this study was to evaluate the effect of activities implemented within a certain health behavior at both the individual and organizational level on the health behavior targeted, using data from a cluster randomized controlled trial.

Materials and methods

Study design and recruitment

Design

For the purpose of the current study, data from a two-armed cluster randomized controlled trial (C-RCT), including four organizations was used (15). The C-RCT was conducted between January 2022 and March 2024 and included baseline and follow-up measurements at six and twelve months after baseline. Data from the baseline and twelve months follow-up measurement were used for the current study. Randomization for the C-RCT took place on the level of location for each organization, meaning that within each organization there was a control and intervention condition (Fig. 1).

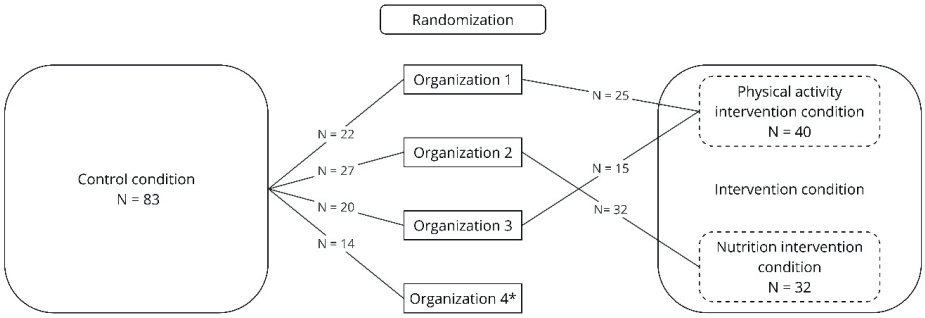

Figure 1. Number of participants in the control and intervention conditions.

*As organization 4 did not implement activities for physical activity or nutrition, it was not considered in the intervention condition.

Within the intervention condition, organizations chose to implement activities from the catalogue according to the criteria of the integrated WHPP. In our study, the organizations implemented activities on three health behaviors, i.e. physical activity, nutrition and mental balance. Two organizations implemented activities on the individual and organizational level targeting physical activity, these were therefore referred to as the 'physical activity intervention condition'. For nutrition there was one organization that implemented activities on the individual and organizational level, and is therefore referred to as the 'nutrition intervention condition'. Due to a small number of participants receiving the activities targeting mental balance (n = 18), this health behavior, and thus this intervention condition, was excluded for the current study. The two intervention conditions were

compared to the control condition, including the control departments within all four organizations. The study design is displayed in Fig. 2.

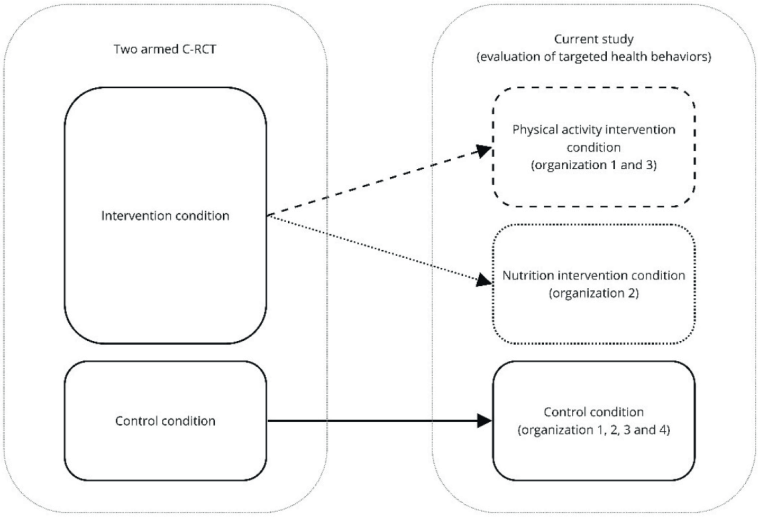

Figure 2. Design of the study to evaluate the effect on the targeted health behaviors.

The Medical Ethical Committee of Amsterdam University Medical Center (A-UMC, Amsterdam, the Netherlands, former Medical Ethical Committee of VU University Medical Center) has approved the study protocol (2021.0402). The trial is registered in the Dutch Trial Register (LTR) under the number NL9526. The recruitment, randomization and sample size calculation have been described in detail in a protocol paper (15).

Recruitment of organizations

Four Dutch organizations participated in the C-RCT; two educational organizations, an assurance, tax and consulting organization and a retail organization. Recruitment of the organizations was conducted through the networks of the research team, colleagues and branch specific networks. To be included organizations were required to have a minimum of 200 employees and currently not have implemented a WHPP comparable to the integrated WHPP, i.e. a program including activities at the individual and organizational level for multiple health behaviors.

Recruitment of participants

Various communication channels were utilized to inform employees within the participating organizations about the study, e.g. e-mail, newsletters, Microsoft

Teams and/or internal websites. Next, all employees received an invitation for an information session that took place online or at the workplace and provided detailed information about the study. Employees who decided to participate signed an informed consent and completed an eligibility checklist.

Employees were eligible for inclusion when they were working for one of the participating organizations for at least 12 h per week, and had an employment contract that either lasted until the final measurement or was extended to it. Employees were excluded for participation when they were on sick leave for more than four weeks or were pregnant.

Randomization and blinding

Two independent researchers carried out the block randomization, which took place after the baseline measurement using a computer program (19). Clusters, composed based on working location, allocated to the intervention condition received the intervention materials (see: 2.3 Intervention) and were instructed to implement the integrated WHPP within six months after randomization. The researcher involved in data processing and analyses was blinded for condition allocation. A number of 264 employees were needed to statistically demonstrate a 10% lifestyle improvement, as measured by the Simple Lifestyle Indicator Questionnaire.

Intervention

Within each organization, a contact person received the intervention materials, i.e. a catalogue with health promoting activities on both the individual and organizational level and multiple health behaviors (i.e. physical activity, nutrition, mental balance, sleep, smoking and alcohol consumption) and 2) an implementation plan to support implementation (15). The first step in the implementation plan was to compose a working group within each organization consisting of HR professionals, employees and supervisors. The working group selected and implemented activities from the catalogue in the intervention condition, examples of activities are offering the possibility of an appointment with a dietitian of physical therapist, replace sitting desks with sit-stand desks or offer free fruit at the workplace (Appendix 1). Moreover, activities in the catalogue varied in implementation costs and effort and intensity. To meet the criteria of the integrated WHPP, they were asked to implement at least one activity at the individual and one activity at the organizational level, where both had to be performed for at least two health behaviors within six months after the start of the implementation. This means that at least four activities had to be implemented by each organization.

Data collection

Participants received an online questionnaire at baseline, six and twelve months of follow-up, including questions about the health behaviors that were covered in the catalogue and overall lifestyle. Below, only the health behaviors that have been targeted on both the individual and organizational level in the integrated WWHP (and are thus evaluated) are described.

Physical activity

The validated Short QUestionnaire to ASsess Health-enhancing physical activity was applied to measure physical activity (SQUASH) (20). The SQUASH questionnaire measures the amount of time spent during a regular week in the past month in four different physical activity domains: commuting, occupational, household, and leisure time. Outcome measures included in the current study were: minutes of light physical activity (LPA), moderate physical activity (MPA) and vigorous physical activity (VPA) per week. All these measures encompass the total time per participant (in minutes per week) spent in physical activity, across the four physical activity domains.

Nutrition

The organization targeting nutrition, focused on the consumption of sugary drinks and fruit. Questions regarding the consumption of sugary drinks were answered on a five point scale (i.e. <1, 1–7, 7–14, 14–20 and ≥ 21 sugary drinks per week). The highest four categories were merged into one because of the small amount of participants in these categories, leading to two categories (<1, vs ≥ 1 sugary drinks per week) (21). A question about fruit consumption was included in the nutrition component of validated Simple Lifestyle Indicator Questionnaire (SLIQ) (22, 23). The question was answered on a six-point scale and converted to two categories that indicate whether guidelines regarding fruit consumption were met (<2 vs ≥ 2 pieces per day) (24).

Covariates

Data about sex, age, educational level, self-reported chronic diseases, self-perceived health measured by the RAND-36, and physical job intensity was collected during baseline (25).

Data analysis

Data from baseline and the twelve months follow-up measurement were used for the analyses. Descriptive analyses were conducted for the control condition and the two intervention conditions. Both within and between conditions differences were

assessed. For continuous outcome measures (i.e. LPA, MPA and VPA), the differences between control and intervention condition were studied by linear multilevel analyses with two identified levels (working location and individual). To assess the differences within both conditions for continuous outcome measures after twelve months, linear multilevel analyses for each condition with an additional level (time) were conducted.

For dichotomous outcomes (i.e. consumption of sugary drinks and fruit), generalized estimating equations (GEEs) were employed to examine differences within and between the control and intervention condition. For the between condition analysis, the GEE was adjusted for clustering at working location level. For the within condition analysis, the GEE was adjusted for the clustering of repeated measures. An additional adjustment for organization was included, this was only relevant for the control condition since the 'nutrition intervention condition' consisted of one organization.

Firstly, a crude analysis (for within condition differences) and an analysis with an adjustment for baseline value of the outcome measure (for between condition differences) was performed (model 1). Secondly, the analyses were adjusted for demographic factors (age, sex and educational level) and self-perceived health measured at baseline (model 2). To assess differences between drop-outs and participants, t-tests and Fisher tests were conducted. Additionally a Bonferroni correction was performed to account for multiple comparisons. All statistical analyses were performed using Rstudio version 2023.03.1 (lme4 and geepack) (26-28).

Results

Demographics

In the control condition almost half of the participants was female the intervention conditions from 53.1% (nutrition intervention condition) to 70.0% (physical activity intervention condition). The mean age varied between 36.6 years (nutrition intervention condition), 44.7 years (control condition), and 45.1 years (physical activity intervention condition). In all conditions more than two third of the participants had a high educational level and low physical work load.

Table 1. Baseline characteristics for the control condition and two intervention conditions.

	Control condition (n= 83)[a]	**Physical activity Intervention condition (n = 40)[b]**	**Nutrition intervention condition (n = 32)[c]**
Sex, female, n(%)	39 (47.0)	28 (70.0)	17 (53.1)
Age, mean (SD), years	44.7 (11.2)	45.1 (10.1)	36.6 (12.2)
Educational level, n(%)			
Low to moderate education	27 (32.5)	11 (27.5)	8 (25.0)
Higher education	56 (67.5)	29 (72.5)	24 (75.0)
One or more chronic diseases[d], n(%)	36 (43.4)	18 (45.0)	5 (15.6)
Work			
Low physical working load, n(%)	60 (72.3)	28 (70.0)	32 (100.0)
Working hours per week, mean (SD)	35.7 (7.1)	32.4 (8.3)	38.4 (6.5)

[a] Employees in the control condition from organization 1, 2, 3 and 4. [b] Employees in the intervention condition from organization 1 and 3. [c] Employees in the intervention condition from organization 2. [d] Self-reported physical or mental health problems.

Values of the outcome measures at baseline and twelve months of follow-up are displayed in Table 2. Drop-out analyses indicated no differences between drop-outs and participants (Appendix 2).

Implemented activities

At twelve months of follow-up, two organizations implemented activities at the individual and organizational level for physical activity. One organization disseminated information and motivational quotes with regard to physical activity and also placed stickers to nudge individuals towards taking the stairs. Within the other organization exercise workshops and activities were organized by employees. Also, an active personnel day and policy to include the exercise activities in the annual agenda were implemented. For nutrition one organization succeeded to implement activities on both the individual and organizational level. Sugary drinks were replaced by healthy syrups and a tasting of these syrups was organized. Moreover, fruit offered at the workplace increased in variety and quantity. A more detailed overview of the implemented activities can be found in Appendix 3.

Table 2. Minutes of low, moderate and high intensity physical activity, consumption of sugary drinks and adherence to nutrition guidelines with regard to fruit consumption at baseline and twelve months.

Physical Activity		**Control**[a]	**Intervention**[b]
LPA minutes per week, mean (SD)	Baseline	2225.1 (1025.8)	2399.1 (819.4)
	12 months	2243.6 (895.1)	2019.6 (955.4)
MPA minutes per week, mean (SD)	Baseline	589.2 (538.5)	542.7 (605.6)
	12 months	663.0 (557.0)	730.0 (596.2)
VPA minutes per week, mean (SD)	Baseline	123.4 (158.2)	85.0 (142.5)
	12 months	124.5 (171.2)	89.9 (133.6)
Nutrition		**Control**[a]	**Intervention**[c]
Sugary drinks per week, n(%)			
<1 per week	Baseline	39 (47.0)	13 (40.6)
	12 months	32 (52.5)	7 (26.9)
≥ 1 per week	Baseline	44 (53.0)	19 (59.4)
	12 months	29 (47.5)	19 (73.1)
Fruit per day[d], n(%)			
< 2 per day, i.e. no adherence to guidelines	Baseline	47 (56.6)	25 (78.1)
	12 months	33 (52.4)	17 (65.4)
≥ 2 per day, i.e. adherence to guidelines	Baseline	36 (43.4)	7 (21.9)
	12 months	30 (47.6)	9 (34.6)

Abbreviations: LPA = Light Physical Activity, MPA = Moderate Physical Activity, VPA = Vigorous Physical Activity. [a] Baseline: n = 83, 12 months: n = 63, 2 participants did not fully complete the questionnaire. [b] Baseline: n = 40, 12 months: n = 28. [c] Baseline: n = 32, 12 months: n = 26. [d] Pieces of fruit i.e. one apple or a handful of grapes, per day.

Intervention effect

Physical activity

Within condition differences for LPA between baseline and twelve months of follow-up indicated a decrease of 394 min (95%CI: -739.9 to -25.0) spent in LPA in the 'physical activity intervention condition' (Table 3). Time spent in MPA was higher after twelve months of follow-up for the 'physical activity intervention condition' (β: 239.1 min, 95% CI: 28.7–427.3). Despite the decrease in LPA within the 'physical the control condition and 'physical activity intervention condition' (β: 170.6, 95%CI: -591.6 – 250.5). Additionally, although an increase of MPA within the 'physical activity intervention condition' was apparent, no differences between conditions were observed (β: 166.1, 95%CI: -52.6 – 384.0). No within and between condition differences were observed for VPA.

Nutrition

No differences were observed in the within condition analyses for nutrition, except for sugary drinks within the control condition. Participants in the control condition had a lower odds (OR: 0.7, 95%CI: 0.5–0.99) to consume ≥1 sugary drink per week at twelve months of follow-up compared to baseline. No between condition differences were observed with regard to the adherence of fruit intake guidelines (OR: 0.8, 95%CI: 0.2–2.7).

Table 3. Within condition (control and both intervention conditions) and between condition effect estimates of activities implemented for physical activity and nutrition after twelve months of follow-up.

	Within condition (control)[a]	**Within condition (physical activity intervention condition)[a]**	**Between conditions[a]**
LPA, β (CI)	-14.0 (-298.3–289.1)	-394.4 (-739.9 to -25.0)*	-170.6 (-591.6–250.5)
MPA, β (CI)	102.2 (-28.6–226.9)	239.1 (28.7–427.3)*	166.1 (-52.6–384.0)
VPA, β (CI)	-3.7 (-36.5–29.3)	-1.8 (-42.9–39.6)	-5.1 (-60.0–48.7)
	Within condition (control)[a]	**Within condition (nutrition intervention condition)[a]**	**Between conditions[a]**
Sugary drinks, OR (CI)	0.7 (0.5–0.99)*	1.8 (0.7–4.9)	[b]
Fruit consumption, OR (CI)	1.3 (0.8–2.1)	2.4 (0.99–5.8)	0.8 (0.2–2.7)

Abbreviations: LPA = Light Physical Activity, MPA = Moderate Physical Activity, VPA = Vigorous Physical Activity. β = Beta (regression coefficient), CI = 95% confidence interval, OR = Odds Ratio. *indicates a significant difference. [a] Results from model 2, with adjustments for age, sex, education and perceived general health at baseline, are reported. [b] Models did not converge and effect estimates could not be reported.

Discussion

The aim of the current study was to evaluate the effect of WHPP activities implemented on both the individual and organizational level on the targeted health behaviors, i.e. physical activity and nutrition. Our findings indicate no effect of the activities on physical activity and fruit consumption. A difference between the 'nutrition intervention condition' and control condition was observed for the consumption of sugary drinks, in favor of the control condition. Within the control condition, participants had a lower odds to consume ≥1 sugary drink per week at twelve months of follow-up. Within the 'physical activity intervention condition', an increase in MPA and a decrease in LPA was observed.

Reasons for the decrease in LPA within the 'physical activity intervention condition' are unknown, but may be due to the increased allocation of time to MPA. A day can be seen as a closed time frame in which various movement behaviors occur. Thus, if time spent in one behavior decreases, in this case LPA, the total time spent in other behavior(s), for instance MPA, has to increase (29).

Despite the increase of MPA in the 'physical activity intervention condition', no intervention effect was observed based on the results of the between condition analyses. One potential explanation for the absence of an intervention effect is that an increase in mean MPA after twelve months was observed within the control condition as well, although this was not statistically significant. The increase in MPA in both conditions diminishes the difference between the conditions at twelve months of follow-up. Additionally, the small sample size may also have contributed to the lack of a statistically significant intervention effect. The implemented activities mainly targeted some specific sports and taking the stairs. However, taking the stairs was not specifically measured in the questionnaire used in the current study. The- specific sports targeted were not mentioned by employees in the questionnaire. Perhaps employees did not list the sport in the questionnaire as a regular activity they engage in, because workshops regarding each sport only occurred once. Both organizations promoted physical activity through different types of activities, e.g. taking the stairs vs exercise workshops, which may have varied effects on for instance MPA. If activities in one organization increased MPA but those in the other did not, the results from the first might be weakened as both organizations were analyzed together as one 'physical activity intervention condition'. As the aim of the study was to evaluate the effect of activities implemented on both the individual and organizational level, regardless of the type of activity implemented, the organizations were considered in the 'physical activity intervention condition' when they were both implementing activities on the individual and organizational level.

When an individual lacks the appropriate knowledge or skills, or does not have the opportunity to participate in exercise activities, participation in these activities is unlikely to occur (30). Based on the results of the implementation process evaluation of the integrated WHPP, we believe that these factors may have affected participation in the exercise workshops and activities. Namely, the process evaluation indicated that 30% of the employees had sufficient knowledge and information to participate (31). Moreover, the activities sometimes took place at times that did not align with the workday. Resulting in employees not being able to participate as they had already left for home and did not return for the activity.

Additionally, there was no clearly defined schedule or plan in advance regarding the timing of specific activities, this resulted in activities occurring irregularly (31). To obtain a sustainable and measurable change in physical activity, repetition of the desired behavior in a stable context is necessary (32, 33). To illustrate, Kaushal and Rhodes (2015) reported that approximately six weeks of regular exercising were required to adopt new, healthy physical exercise habits (34). Moreover, in a meta-analysis conducted by Rongen et al. (2013), it was reported that weekly activities aiming to improve physical activity and nutrition were four times more effective in comparison to lower frequencies (7). In contrast, exercise activities in our study were implemented irregularly without a certain frequency, which is not sufficient to lead to new healthy physical activity habits.

One organization implemented activities targeting nutrition, with a focus on decreasing the consumption of sugary drinks. Results indicate that the 'nutrition intervention condition' had a higher odds to drink ≥1 sugary drink per week, which was the highest category. Potentially, the healthy syrups that replaced the sugary drinks were still identified as being sugary drinks in the questionnaire by employees. Hence, they might have answered that they still consumed sugary drinks, whereas they were actually consuming the healthy syrups and thus used the implemented activity. Moreover, the consumption of sugary drinks already was low in both the control and 'nutrition intervention condition'. Therefore, the four highest answer categories (i.e. 1-7, 7–14, 14–20 and ≥ 21 sugary drinks per week) were combined due to the low number of participants in these categories. This leaves little room for improvement due to a potential ceiling effect. In addition to the activities targeting the consumption of sugary drinks, the consumption of fruit was targeted. Fruit was already available at the workplace prior to the study, but in the context of the study more fruit and a larger variety was available for employees in the nutrition intervention condition. This adaptation did not result in higher odds of adhering to nutrition guidelines regarding fruit. Thus, as it involved only a minimal adjustment, only a limited effect could be expected.

A systematic review by Engbers et al. (2005) found that WHPPs with an additional environmental component positively impacted fruit consumption, emphasizing the importance of addressing both individual and organizational levels (9). This is further supported by a systematic review of Geaney et al. (2013) suggesting that comprehensive WHPPs encompassing diverse activities at both levels may be essential for reducing consumption of sugary drinks and increasing fruit intake (35). Activities addressing nutritional health behaviors in our study, covering the consumption of sugary drinks and fruit, were implemented at both individual

and organizational levels. Nevertheless, if we focus on the two aspects separately, only activities targeting the consumption of sugary drinks were implemented at both levels, with the individual-level activity being a one-time tasting of healthy syrups. Activities targeting fruit consumption were only implemented on the organizational level. However, the abovementioned systematic reviews imply that more extensive individual and organizational WHPPs, including a combination of various activities on both levels, might be necessary to reduce the consumption of sugary drinks and increase fruit consumption (9, 35). In contrast to our findings, the Lombardy workplace health promotion network (LWHPN), the European Good Practice upon which the integrated WHPP was based, did found an increase of fruit intake based on a non-randomized controlled one-year pilot study (13). An important difference between the LWHPN and the integrated WHPP that might contribute to the difference in effect is the implementation process. Organizations in the LWHPN received support from the Lombardy region and they were part of a comprehensive network that stimulated collaboration between important stakeholders, i.e. organizations, trade unions, and the regional health system. The LWHPN can be considered as more of a regional approach, allowing organizations to collaborate and support each other with the implementation of activities. Additionally, organizations in the LWHPN could receive a vignette if they implement a sufficient amount of activities. This vignette might be an incentive for organizations to actively engage in vitality at the workplace and to implement more extensive activities (11). In contrast, organizations in our study did not receive additional implementation support and could not apply for a vignette within the context of the study. In future studies it is recommended to address this.

Results from the process evaluation of the integrated WHPP indicated that activities were primarily selected based on how quickly they could be implemented (31). Resulting in the implementation of mainly minimal and low intensive activities by the organizations in our study. Combinations of extensive activities or substantial organizational adjustments such as sport activities that occur regularly, continuous dissemination of information materials, the route or placement of healthy products in a company restaurant or adjustments of policy were not implemented (31). However, such type of activities are necessary to impact the health behaviors targeted (7, 9, 35). Possibly, implementation of such activities requires more time than was available within the organizations during the study. Due to the minimal nature of implemented activities, these might be seen as initial steps in encouraging healthy choices, but it cannot be expected that they will induce substantial, sustainable changes in health behavior as became apparent from the present study findings.

Strengths and limitations

Data from a C-RCT was used for this study. As this design aims to mitigate the risk of contamination between the intervention and control condition it can be viewed as a strength. Nevertheless, contamination cannot be avoided completely. The a-priori calculated sample size for the C-RCT was not met. Because of difficulties with the recruitment of organizations (amongst others due to the COVID-19 pandemic) 173 employees were included at baseline, while 264 participants were required at the final measurement. For the purpose of the current study, the sample sizes of the intervention conditions were even smaller, as not all organizations were included in the analysis for physical activity and nutrition. The small sample size and thus limited power is a substantial limitation that might have contributed to the absence of an intervention effect. Thus, the results should be interpreted with caution. Another limitation of the study is the potential for recall bias, given that participants were asked to recall their physical activity from the previous month for the SQUASH questionnaire, which could have resulted in less accurate reporting. Nevertheless, we expect that this had little or no impact on the results, as this reporting bias occurred in both the intervention and control conditions and it is unlikely that it was more or less present in one of the study conditions. Moreover, results cannot be generalized to for instance blue collar workers, as the majority of the study population had a light or low physical workload and a high educational level. It should also be considered that LPA included light work, which comprises sitting or standing work with some walking, such as an office job (20). Sedentary behavior is thus (partially) included in LPA, which might attribute to high levels of LPA in both groups. Results regarding LPA should thus be interpretated with caution, as it does not entirely consists of actual physical activity.

Conclusions

The present study did not show an intervention effect of the implementation of activities on both the individual and organizational level on the targeted behaviors, i.e. physical activity and nutrition. The implemented activities occurred once or irregular, were minimal and low intensive, which may explain the lack of effect. In future WHPPs, efforts should be directed towards more extensive, regular, and intensive activities. Additionally, further research with more power and sufficient time for implementation is warranted.

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Appendices

Appendix 1

Table A1. An overview of activities targeting physical activity and nutrition in the catalogue.

Physical activity	Activity
	Provide information about the health benefits of adequate physical activity through, for example, videos made by employees, supervisors, or students, information on websites, or meetings.
	Offer the possibility of an appointment with a (company) physiotherapist (goal setting, action planning, skill training, seeking advice, etc.). Explore the possibilities for reimbursing these appointments.
	Provide employees with a lifestyle app or promote its use to encourage physical activity.
	Provide employees with a logbook, pedometer, or activity tracker to track goals.
	Offer the opportunity to measure fitness, muscle function, weight, and body composition, etc.
	Use automatic reminders to encourage employees to stand, walk, or take exercise breaks.
	Encourage employees to take the stairs. This can be done with motivational messages and signs, an attractive stairwell (art, music), and making the elevator/escalator less appealing (slowing down elevator doors, elevator, and escalator).
	Organize competitions and challenges to promote physical activity in the daily routine.
	Organize weekly sports groups and/or introductory lessons for new sports.
	Replace individual printers with a shared printer, and place coffee machines further away from workstations.
	Promote active sitting with ergonomic chairs. Make active sitting the standard.
	Replace sitting desks with sit-stand desks. Make standing work the standard (by keeping the desks in the standing position).
	Place light exercise equipment in prominent locations where employees often take breaks.
	Ensure there is good bicycle parking.
	Provide business bicycles for commuting.
	Provide a shower and changing room.
	Offer sports facilities in the work environment. For example, collaborate with a nearby sports provider.
	Seek collaboration with sports education programs and their students.
	Encourage active meetings and active conferencing. Adapt spaces accordingly with standing tables, but also encourage walking meetings.
	Educate supervisors about their role model function, the importance of support and a positive attitude, and how they can encourage employees to be active.
	Ask some employees who are already very active to be ambassadors and motivate colleagues to move more (activity motivators).
	Gather employees who want to contribute ideas and help in a recreation committee to realize more physical activity at work.
	Enable employees with fixed workstations to take breaks and encourage them to do so.
	Provide opportunities to exercise during working hours and make it clear that this is accepted.
	Offer a financial reimbursement for sports activities, for example, a gym membership or other sport.

Table A1. Continued

Nutrition	Provide information about the importance of healthy nutrition through, for example, videos made by employees, supervisors, or students, information on websites, or meetings.
	Provide remote workers with information about healthy eating at the home workplace. For example, refer to the website of the Nutrition Center.
	Make a nutrition app available, such as My Eetmeter (recommended by the Nutrition Center). Promote this for insights into health, advice, and tracking personal goals.
	Provide the opportunity to measure weight, body fat percentage, etc.
	Offer the possibility of an appointment with a dietitian (goal setting, action planning, skill training, seeking advice, etc.).
	Provide the opportunity to eat in the company restaurant or a restaurant with a healthy menu. Offer a reimbursement for this if necessary.
	Adjustments to the company restaurant (also applicable to vending machines) including – Greater availability of healthier choices*: offer at least 60% healthier choices in each product group. – Encourage healthy choices. Only advertise healthy food and drink and offer only healthier choices at the checkout. – Make healthier choices stand out. Present them in a prominent and attractive way, for example, at the front, at eye level, or on a raised platform. Adjust the walking route so that healthy choices are seen first.
	Provide shift workers with the opportunity to eat healthy.
	Ensure accessible water taps and dispensing points.
	Provide an area with a kitchen so that employees can store or prepare their own food.
	Serve healthy snacks at meetings and gatherings.
	Offer free fruit at the workplace.
	Provide refrigerated storage for lunch packs for employees who travel frequently (e.g., a small cooler bag).
	Educate supervisors about their role model function, the importance of support and a positive attitude, and how they can encourage employees to eat healthy.
	Form a Nutrition working group with employees who want to contribute ideas and help realize healthy eating in the workplace.
	Provide paid lunch breaks. This encourages having a meal at work.
	Lower the prices in the company restaurant for healthy choices.

Appendix 2

Table A2. Drop-out analyses for the control condition, physical activity intervention condition and nutrition intervention condition, reporting baseline values and p-values of descriptive and outcome measures.

Variable	Control condition		
	Mean/ n(%) participants	Mean/ n(%) drop-outs	p-value
Sex, female[a]	28 (44.4%)	11 (55.0%)	0.45
Age, years[b]	45.1	43.4	0.58
Higher educational level[a]	40 (63.5%)	16 (80.0%)	0.27
One or more chronic diseases[a, c]	26 (41.3%)	10 (50.0%)	0.61
Low physical working load[a]	46 (73.0%)	14 (70.0%)	0.78
Working hours per week[b]	35.5	36.2	0.69
LPA, minutes per week[b]	2375.2	1752.5	0.03
MPA, minutes per week[b]	531.4	771.2	0.19
VPA, minutes per week[b]	130.0	102.8	0.45
≥1 Sugary drinks per week[a]	37 (58.7%)	7 (35.0%)	0.08
≥2 Pieces of fruit per day[a]	26 (41.3%)	10 (50.0%)	0.61

A significance level of $p < 0.005$ with Bonferroni correction was applied to account for multiple comparisons. Abbreviations: LPA = Low physical activity, MPA = Moderate physical activity, VPA = Vigorous physical activity. *indicates a significant difference at baseline between drop-outs and participants. [a] Fisher test was conducted to assess baseline differences between participants and drop outs. [b] t-test was conducted to assess baseline differences between participants and drop outs. [c] Self-reported physical or mental health problems. [d] No differences in physical workload within the nutrition intervention condition.

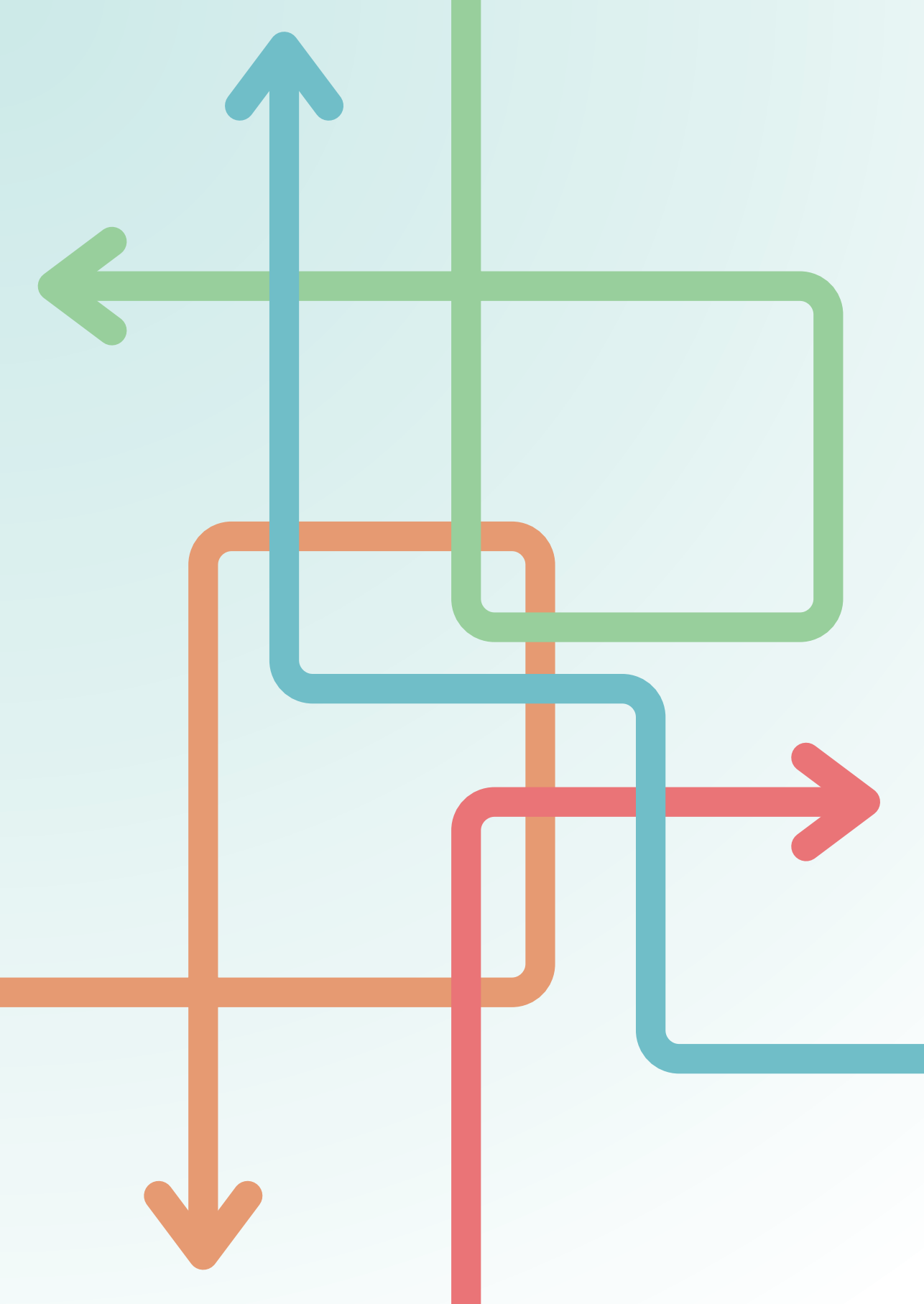
Physical activity intervention condition			Nutrition intervention condition		
Mean/ n(%) participants	**Mean/ n(%) drop-outs**	**p-value**	**Mean/ n(%) participants**	**Mean/ n(%) drop-outs**	**p-value**
20 (71.4%)	8 (66.7%)	1.0	13 (50.0%)	4 (66.7%)	0.66
46.0	42.8	0.40	34.8	44.3	0.15
20 (71.4%)	9 (75.0%)	1.0	21 (80.8%)	3 (50.0%)	0.15
11 (39.3%)	7 (58.3%)	0.32	3 (11.5%)	2 (33.3%)	0.22
18 (64.3%)	10 (83.3%)	0.28	[d]	[d]	[d]
32.3	32.7	0.88	39.1	35.3	0.24
2417.1	2357.1	0.86	n.a.	n.a.	n.a.
460.5	734.6	0.37	n.a.	n.a.	n.a.
92.5	67.5	0.56	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	17 (65.4%)	2 (33.3%)	0.19
n.a.	n.a.	n.a.	5 (19.2%)	2 (33.3%)	0.59

Appendix 3

Table A3. An overview of the activities implemented within the physical activity and nutrition health behaviors.

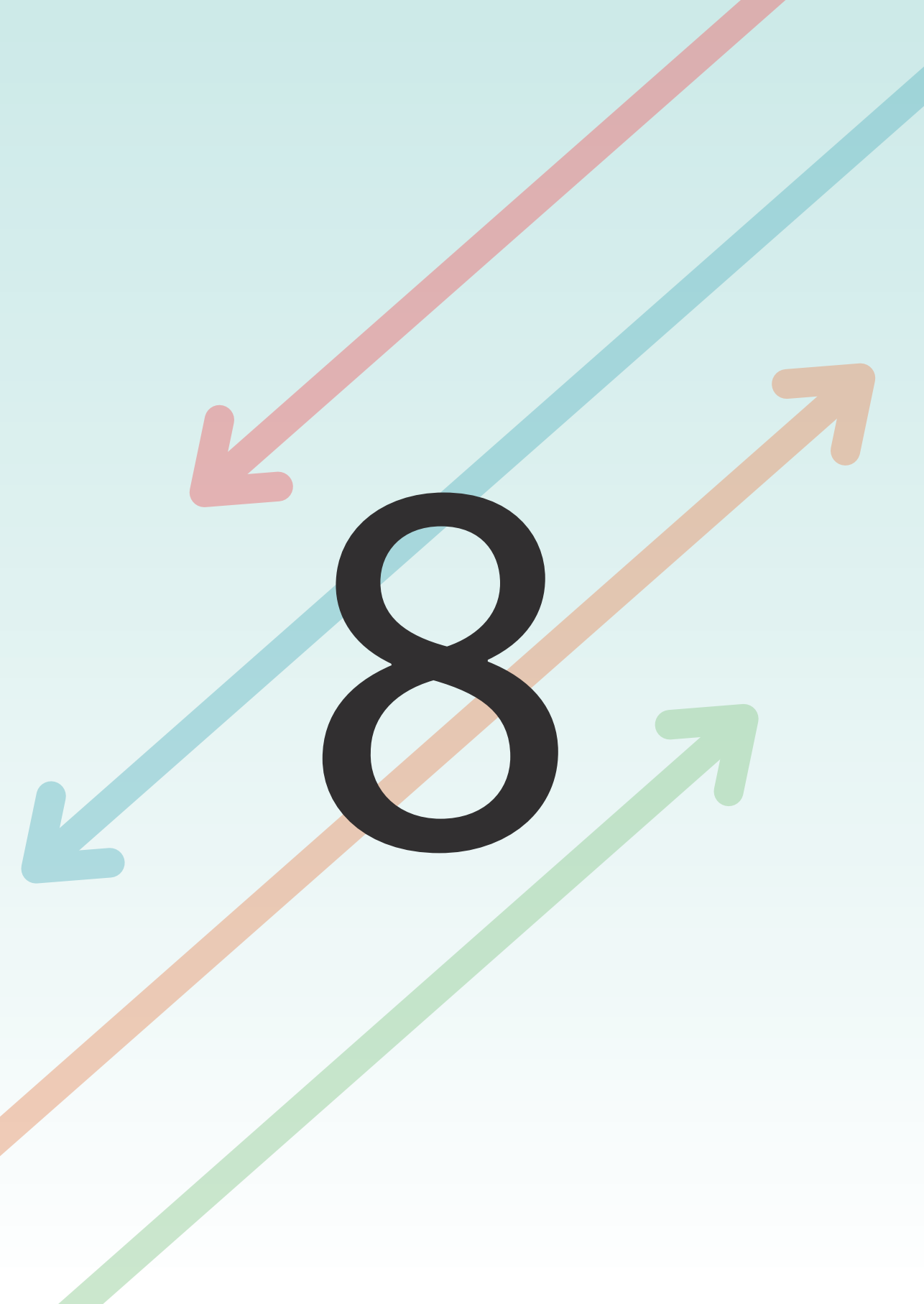
	Physical activity		**Nutrition**
	Organization 1[a]	***Organization 3***[a]	***Organization 2***[b]
Individual level	Infographic informing employees about the WHP offer regarding physical activity	Exercise workshops organized by employees	A tasting of healthy syrups to replace sodas
	Motivating quotes on posters and digital screens	Exercise activity after personnel day	
	Healthy breakfast including an educational component about physical activity		
Organizational level	Nudges to take the stairs	Active personnel day	Healthy syrups and a water tap with cold and sparkling water to replace sodas
		Policy to include exercise activities and workshops in annual agenda	An expansion of fruit offered at the workplace, both in diversity and quantity[c]
			Healthy snacks during meetings and gatherings[d]

[a] Educational organizations. [b] Tax and consulting organization. [c] This activity was implemented within two out of three locations from organization 2. [d] This activity was implemented within one out of three locations from organization 2.



Part III

Sedentary behavior and vitality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Chapter 8

Exploring associations between device-based occupational sedentary behavior and need for recovery in white collar workers: A compositional data-analysis

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Abstract

Objectives: White collar workers spend an increasing amount of time in occupational sedentary behavior (OSB) and are thereby at risk for adverse health outcomes. Nevertheless, the association between OSB and the need for recovery (NFR), an important indicator of wellbeing, is unknown and therefore examined.

Methods: Baseline data from a cluster randomized controlled trial was used. A subgroup of 89 white collar workers wore a triaxial accelerometer for 7 days. NFR was measured using the Questionnaire on the Experience and Evaluation of Work. Compositional data analysis was applied to determine the composition of different OSB bouts (short, medium and long) and occupational physical activity (OPA) (light, moderate and vigorous and standing). Linear regression analyses were performed to explore the associations between occupational compositions and NFR.

Results: Relatively more time spent in long OSB bouts was associated with a lower NFR (β: −11.30, 95% CI: −20.2 to −2.4). Short and medium OSB bouts and OPA were not associated with NFR.

Conclusion: Associations between OSB bouts, OPA and NFR hinted at contrasting trends, suggesting the need to consider different bout lengths of OSB in future studies.

Keywords: Triaxial accelerometer, Sitting, Low physical workload, Duration of prolonged sitting, Office workers

Introduction

The association between physical activity (PA) and various health benefits is widely acknowledged (1, 2). In addition to PA, attention for sedentary behavior (SB) is growing. A sedentary lifestyle is one of the key risk factors for various health problems, including diabetes, cardiovascular diseases, and all-cause mortality (3). SB is defined as "any waking behavior characterized by an energy expenditure lower than 1.5 metabolic equivalents while in a sitting, reclining or lying posture" (4). Besides adverse physical health outcomes, mental health outcomes, such as depression, are also linked to excessive SB (5, 6). As there has been a shift towards more sedentary work in the past decades, attention for SB has become increasingly relevant (7). Especially since occupational SB (OSB) is a major part of the total daily sedentary time in office-based employees. On average 60% of occupational time is spent sedentary in working adults, with up to 79% in office-based employees (8, 9). Moreover, the duration of SB is higher on working days than on non-working days (10).

As mentioned above, both PA and SB are known to be related to physical and mental health components. In addition, high levels of self-reported SB have shown to be associated with increased fatigue and a decrease in mental wellbeing among employees (11-13). A measure to specifically indicate work-related physical and psychological fatigue is the need for recovery (NFR) (14, 15). The NFR is the need to recuperate from work induced efforts and the short-term workload effects after a day at work (15). A consistently high NFR among employees is known to be associated with several health issues, including cardiovascular diseases, neck and upper limb complaints, fatigue and emotional exhaustion (15-18). Additionally, a high NFR is associated work-related issues, such as increased absenteeism, occupational disability and early retirement (19-21). Insight into work-related factors that lead to an increased NFR is necessary to prevent these health and work-related issues. The association between occupational PA (OPA) and NFR has been studied (22-25). Coffeng et al. studied the association between OPA and NFR in office workers and found that, amongst others, stair climbing and (physical) detachment at work positively affected NFR. Implying that higher levels of OPA were associated with a lower NFR (22). Two other studies indicated that increased OSB was associated with a lower NFR (24, 25). However, the study population in these studies consisted of mainly employees with physically demanding jobs, implying that the results are specific to this occupational group (25). Ketels et al. reported that increased OSB in physically demanding jobs attributes to the necessary breaks and subsequently leads to a decrease in the NFR, which is equivalent to an improvement (25). However, for employees with predominantly sedentary work,

higher levels of OSB might lead to unhealthy high levels of daily SB (26). Hence, it is important to investigate the association between OSB and NFR in white collar workers, specifically.

Prolonged continuous SB of >30 min is associated with a higher risk to develop cardio-metabolic diseases, obesity or musculoskeletal disorders. On the other hand, breaks of SB, leading to shorter bouts of SB are positively associated with indicators of cardio-metabolic health (10, 27, 28). It is therefore important to consider different bout lengths of OSB, when exploring the association between OSB and NFR in white collar workers. In doing so, it is of importance to consider the compositional nature of these different behaviors. To illustrate, a workday may consist of a closed frame of 8 h and consists of a combination of being sedentary, e.g., sitting at a desk or physically active, e.g., standing at a desk, walking. If time spent in one behavior increases then the total time spent in other behavior(s) logically decreases (29). Thus, the time spent in one kind of movement behavior is only meaningful when the time spent in other movement behaviors is also taken into account (30). Nevertheless, in previous studies different movement behaviors, such as physical activity and sedentary behavior, are considered to be separate variables, independent from each other (26, 31). Although they are actually complimentary parts of a composition (31). To incorporate different movement behaviors in a composition, compositional data analysis (CoDA) can be applied (30, 32, 33). As this analysis considers the total combination of behaviors, e.g., all movement behaviors during a working day, instead of one single component, it is recommended to apply CoDA (30, 31, 33). Recent studies in both the occupational and other domains already applied CoDA (24, 26, 30, 34).

Considering the above, the aim of this study was to explore the association between occupational compositions, including relative time spent in different OSB bouts and OPA, and the NFR in white collar workers, using CoDA. The research question was therefore (how) are different bout lengths of OSB and OPA associated with the NFR?

Methods

Study design

This study used baseline data of a subgroup of participants from the Work towards Vitality-study, a cluster-randomized controlled trial to evaluate the effectiveness of an integrated WHPP (35). Ethical approval for the study protocol (2021.0402) was provided by the Medical Ethical Committee of the Amsterdam University Medical

Center (A-UMC, Amsterdam, the Netherlands, former Medical Ethical Committee of the VUmc). The trial (NL9526) is registered in the Netherlands Trial Register. All participants provided written informed consent before participation.

Recruitment

Participants were recruited from three organizations in different occupational sectors, i.e., two educational organizations and an assurance, tax and consulting organization. The participating organizations were recruited through the networks of the research team, co-workers and branch specific networks. Employees were recruited and informed via different communication channels, including intranet and newsletters. Additionally, all employees within the participating organizations were invited for an information session in which detailed information about the study was provided. Employees who were interested in participating in the study received and information letter, eligibility checklist and informed consent at home by post. For further details on the recruitment and details of the study design, we refer to Smit et al. (35). For the Work towards Vitality-study, participants had to work at least 12 h per week and were excluded if they were on sick leave for more than four weeks or were pregnant. A total of 173 employees provided baseline data. For practical reasons, i.e., the availability of triaxial accelerometers, a random selection of these, i.e., the first 99 participants, were instructed to wear a triaxial accelerometer for seven consecutive days. Participants categorized as blue collar workers were excluded for the purpose of the current study (n = 7). Finally, a total of 89 participants were included, due to missing accelerometer data (n = 3).

Data Collection

The online questionnaire including the NFR subscale of the Questionnaire on the Experience and Evaluation of Work and the accelerometer with the user instructions and diary were sent to the participants at the same moment. Some participants immediately wore the accelerometer upon completing the questionnaire, where others delayed wearing the accelerometer and/or completing the questionnaire for unknown reasons. However, both measurements took place in the same period.

Need for Recovery

The need for recovery (NFR) was measured using the corresponding subscale of the valid and reliable (r = 0.87) Questionnaire on the Experience and Evaluation of Work (15, 36). Content validity was assessed by comparing NFR scores with measurement scales about fatigue at work and stress related health complaints. This showed that the NFR is a valid indicator (r = 0.65) of work-related physical and psychological fatigue (15). The subscale comprised of 11 statements to be answered with yes or

no, in which a score of 0 was assigned to the positive answer and 1 to the negative answer. An example of a statement is "Because of my job, I feel quite exhausted at the end of a working day." The total score, i.e., the sum of the items, was standardized to a score between 0, i.e., the lowest NFR possible (most favorable score) and 100, i.e., the highest NFR possible (least favorable score).

Sedentary Behavior

Participants were instructed to wear a triaxial accelerometer on the hip for 24 h during seven consecutive days and to keep an activity diary to keep record of their working hours. Due to practical reasons two types of triaxial accelerometers were used to device-based measured movement behavior: the UKK RM42 and the ActiGraph GT9X Link. The UKK RM42, worn by 31 participants from organization 1, collected data within a range of ±16 g at a sampling rate of 100 Hz. The ActiGraph

GT9X Link, worn by 58 participants from organization 2 and 3, had the range ±8 g at the sampling rate 30 Hz. To address differences between the sampling rate, the raw data from both types of accelerometers were processed identically, using validated mean amplitude deviation and angle for posture estimation algorithms in 6-second epochs (37). The mean amplitude deviation algorithm describes the intensity of physical activity (PA) based on acceleration and has been found to be valid and accurate for raw triaxial accelerometer data (38). The angle for posture estimation algorithm is responsible for measuring body posture, i.e., lying, sitting and standing and has been found to be accurate and specific (39). The epoch-wise accelerometer output values were further smoothed by 1 min exponential moving average for each epoch time point. Therefore, short artifacts, i.e., accelerations not related to movements of interest, do not interrupt the bout calculation. In this study, only occupational time was taken into account, thus non-working days and non-working hours were excluded. The time spent in continuous OSB was split into short bouts (0–10 min), medium bouts (10–30 min) and long bouts (>30 min) of continuous OSB (10, 27, 40). All movement behaviors other than OSB, i.e., standing, and light, moderate and vigorous PA, were considered as OPA. The bouts ending during working hours were included in the dataset. Data was classified as non-wear time if a sequence of more than 120 consecutive minutes of 0 activity was detected (41). Non-wear time was excluded before the data was analyzed.

Covariates

Data about sex, age and organization was collected using an online questionnaire. The mean of the bout-based total work time was log transformed to account for the differences in working hours between participants.

Statistical Analyses

The occupational composition, consisting of the four movement behaviors (short bouts of OSB, medium bouts of OSB, long bouts of OSB, and OPA), was transformed to a set including three isometric log ratios (ilr) (31, 33). For the first ilr (ilr1), the first movement behavior, e.g., short OSB, was the numerator and the denominator was the geometric mean of all other movement behaviors, e.g., medium, long and OPA. The second ilr (ilr2) represented the relative time in the second movement behavior, e.g., medium OSB, versus the remaining movement behaviors, e.g., long and OPA, and so on (33). By rotating the sequence of the movement behaviors, each behavior was considered as the first compositional part (the numerator) once. This resulted in four ilr sets (each including three ilrs), one set for each movement behavior (Appendix 1). In each ilr set, the first ilr coordinate (ilr1) represented the relative importance of the first movement behavior.

To study the associations between relative time spent in each movement behavior and the NFR, four linear regression analyses were conducted, i.e., one for each movement behavior. In model 1, the ilr2 and ilr3 from the ilr set of the corresponding movement behavior and the log-transformed mean total work time were included. In model 2, three additional potential confounders, i.e., age, sex and organization, were included. All analyses were conducted in RStudio version 2023.03.1 (The R Foundation for Statistical Computing, Vienna, Austria) using the stats package and the compositions package v2.0-6 (42, 43). The β and 95% confidence interval of each ilr1 was reported.

Results

Participant characteristics

Participant characteristics are presented in Table 1. The mean age of the participants was 41.4 years (SD = 11.1) and 38.2% was female. The majority of the participants (66.3%) worked partly from home, about a third worked fulltime at their workplace (30.3%) and a small proportion worked fully from home (3.4%). Most participants classified their job as low physical load (91.0%). Self-reported work hours ranged between 16 and 50 h per week with a mean of 35.4 (SD = 7.4). Self-reported working days ranged between 2 and 5 days per week with a mean of 4.4 (SD = 0.8).

Table 1. Participant characteristics.

Descriptive variable	Overall (N = 89)
Age in years, mean (SD)	41.4 (11.1)
Sex, female n (%)	34 (38.2%)
Work situation	
Always working at workplace n (%)	27 (30.3%)
Working from home fulltime n (%)	3 (3.4%)
Working from home, parttime n (%)	59 (66.3%)
Job intensity[a]	
Moderate physical load n (%)	3 (3.4%)
Low or light physical load n (%)	86 (96.6%)
Work hours per week, mean (SD)	35.4 (7.4)
Working days per week, mean (SD)	4.4 (0.8)

[a]Moderate physical load: Some physical load at work, for instance occasionally lifting heavy objects. Low or light physical load: A sedentary or standing occupation, including walking but no high intensity physical activity.

Outcome measures and related measures are reported in Table 2. On average, participants spent 5.1 h per day (SD = 1.3) in OSB and 2.8 h per day (SD = 1.1) in OPA. More specifically, 16.3% of the total workday was spent in short OSB, 23.5% in medium OSB, 23.3% in long OSB and 36.8% in OPA. The mean score for the NFR was 32.0 (SD = 29.7).

Table 2. Outcome variables and related variables as measured by the triaxial accelerometers and need for recovery questionnaire.

Outcome measure	Result
OSB hours per day, mean (SD)	5.1 (1.3)
OPA hours per day, mean (SD)	2.7 (1.1)
Short OSB bouts, mean % of the total workday[a]	16.3%
Medium OSB bouts, mean % of the total workday[b]	23.6%
Long OSB bouts, mean % of the total workday[c]	23.3%
OPA bouts, mean % of the total workday	36.8%
Need for recovery, mean, (SD)[d]	32.0 (29.7)

Abbreviations: OSB, Occupational sedentary behavior; OPA, Occupational physical activity. [a]Bouts of 0–10 min of OSB. [b]Bouts of 10–30 min of OSB. [c]Bouts of >30 min of OSB. [d]NFR, ranges from 0 to 100.

Occupational compositions and the need for recovery

Results from model 1 (β = −12.2, 95% CI = −21.7–−2.7) and model 2 (β = −11.3, 95% CI = −20.2–−2.4) indicate that more time spent in long OSB bouts, relative to short-, medium- and OPA bouts was associated with a lower need for recovery (Table 3).

Albeit the three other associations, i.e., short and medium OSB and OPA with NFR, were not statistically significantly associated, trends in different directions for each variable were apparent. We observed a negative effect size suggesting lower NFR when more time was spent in short OSB bouts relative to medium-, long- and OPA bouts according to both model 1 (β = −11.0, 95% CI = −29.7– 7.7) and 2 (β = −18.3, 95% CI = −37.1 – 0.5). Further, for more time spent in medium OSB bouts (model 1: β = 8.9, 95% CI = −11.1 – 28.9, model 2: β = 16.2, 95% CI = −3.0 – 35.4) and OPA (model 1: β = 14.2, 95% CI = −3.8 – 28.9, model 2: β = 13.4, 95% CI = −5.0 – 31.8) relative to the other bouts, positive effect sizes, though not statistically significant, were apparent indicating a higher NFR.

Table 3. Effect estimates and 95% confidence intervals of the four linear regression analyses for the associations between irl1 (from each movement behavior) and the need for recovery.

Ilr1 of the first movement behavior	**Model 1[a]**		**Model 2[b]**	
	β	**95% CI**	**β**	**95% CI**
Short OSB bouts	-11.0	-29.7 – 7.7	-18.3	-37.1 – 0.5
Medium OSB bouts	8.0	-11.1-28.9	16.2	-3.0 – 35.4
Long OSB bouts	-12.2	-21.7 to -2.7*	-11.3	-20.2 to -2.4*
OPA bouts	14.2	-3.8 -32.2	13.4	-5.0 – 31.8

Abbreviations: OSB, Occupational sedentary behavior; OPA, Occupational physical activity. *Significant association. [a]Model 1 adjusted for ilr2, ilr3, and the log transformed mean worktime. [b]Model 2 additionally adjusted for age, sex, and organization.

Discussion

The aim of the current study was to explore the associations between relative time spent in different OSB bouts and OPA and the need for recovery in white collar workers. Results indicate an association between more time spent in long OSB bouts relative to the other OSB bouts and OPA and a lower need for recovery. There was a negative effect size, though not statistically significant, suggesting a lower need for recovery, when more time was spent in short OSB bouts relative to the other OSB bouts and OPA. On the other hand, for more time spent in both medium OSB bouts and OPA relative to other OSB bouts, positive effect sizes though not statistically significant, indicating a higher need for recovery were observed.

Two previous studies investigated associations between different occupational movement behaviors, including OSB, and NFR, of which one study also applied CoDA (24, 25). Stevens et al. included occupational SB, standing, light PA, and moderate to vigorous PA in their compositions (24). Ketels et al. studied the

associations between occupational SB, standing and moderate to vigorous PA and NFR (25). Both studies indicated that more time spent in overall OSB compared to the other occupational movement behaviors resulted in a lower need for recovery (24, 25). This finding is in line with results from our study. However, two notable differences between these studies and our study should be considered. First of all, both Stevens et al. and Ketels et al. did not make a distinction between different bout lengths of OSB (24, 25). Secondly, the study populations differed from our study. Stevens et al. included predominantly employees with physically demanding jobs and a small proportion of white-collar workers, i.e., administration workers (24) and Ketels et al. only included employees with physically demanding jobs (25).

In our study, the results pointed in different directions for the different bout lengths. This indicates that the different bout lengths should be considered in future studies exploring OSB. Furthermore, the bout lengths can also be specified further. We focused on bout lengths of 0–10 min, 10–30 min and those exceeding 30 min of OSB, as detrimental health outcomes are associated with prolonged sitting of over 30 min (10, 28). However, in potential there might also be a different association with NFR for sitting continuously for 30–60 min and bouts longer than 60 min. In our study, we concentrated solely on participants classified as white-collar workers. In future studies that further explore the associations between OSB and NFR, it is important to capture a broader range of occupational contexts and consider the specific occupations that vary in (physical) work demands. For instance, the workday of a teacher might differ substantially from the workday of an office worker with regard to OSB and OPA.

As prolonged SB is known to be a risk factor for, amongst others, diabetes and cardiovascular diseases, the finding that more time spent in long OSB bouts relative to the other OSB bouts and other movement behaviors was associated with a lower need for recovery might be unexpected (3). Another striking observation was that effect sizes in different directions were apparent for the different OSB bouts and OPA. The impact of task interruption might be a possible explanation for the observed trends in opposite directions. According to Mark et al., it takes approximately 25 min to resume a task after an interruption (44). Interruptions cause an increase of task completion time and a decrease of task performance (45). Which in turn can lead to unfinished work and tasks at the end of the day. Unfinished work or tasks are identified as a job-related stressor and may result in diminished detachment from work which subsequently might lead to a higher need for recovery (46, 47). Long OSB bouts might imply less interruptions from work tasks and thus a lower need for recovery after work. However, medium OSB bouts indicate that the participants

interrupted sitting within 30 min, and potentially also their task. This might be attributed to increased task completion time and unfinished work at the end of the day, resulting in a higher need for recovery. Although formulating concrete recommendations for practice based on the results of an exploratory study might be too early, existing literature supports dynamic workplaces such as desk bikes or sit/stand stations that allow posture changes and could thus interrupt OSB, without interrupting cognitive work and productivity (48-50).

As cross-sectional data was used for this study, it cannot be assumed that the association between medium OSB bouts and a higher need for recovery is causal. The possibility that a high NFR affected the OSB bouts should therefore be considered. For instance, an employee with a high need for recovery might have difficulties with regaining concentration and completing tasks. If they also interrupt OSB when they are not able to finish a task, this can lead to more medium OSB bouts (15). Longitudinal studies using accelerometry are required to gain more insight in the causal relationship between different OSB bouts and NFR as well as underlying mechanisms. In our study, the activities and tasks conducted during a workday throughout the accelerometry measurement period were not reported, but provide more insight in the association between OSB bouts and the need for recovery. Hence, more detailed information about the tasks throughout a workday should be gathered in future studies.

OPA bouts included standing and different intensities of physical activity. Potentially, results might have been different if standing, light PA and moderate to vigorous PA were considered as separate movement behaviors, which is also reported in another study (25). Higher levels of OPA could indicate employees are attending a large amount of appointments that require them to walk to another location. A high number of consecutive appointments on a day may induce fatigue or stress, potentially affecting the NFR. A larger amount of OPA could also indicate more breaks for both OSB and completing tasks. This could attribute to the observed higher need for recovery associated with OPA bouts.

A strength of the study is the device-based movement behavior during occupational time, which is more reliable than subjectively measured movement behavior by questionnaires or activity diaries (51). Another strength of this study is the application of CoDA and including different bout lengths of OSB. As it accounts for the codependency between movement behaviors, enhancing the robustness of the findings.

Two types of accelerometers were used, which may be considered a limitation. However, discrepancies in the sampling rate (100 Hz vs. 30 Hz) were addressed by using the same algorithms which are proven to enable comparison of accelerometer data irrespective of accelerometer features such as sampling rate, range and resolution (37). Another limitation is the small sample size included (n = 89). A post hoc power analysis, based on an R2 of 0.1, 7 determinants and an alpha of 0.05, revealed that the power of the current study was 56%. Given this power, it might not have been feasible to detect significant associations. Studies including a larger sample and thus greater power, are necessary to gain more insight in the associations between OSB bouts, OPA and NFR. Lastly, the working hours reported in the diary and derived from the accelerometer were not fully synchronized. All bouts that ended during a working day were included. However, it could occur that a participant was in a certain movement behavior and ended the working day, i.e., time reported in the diary, but remained in this movement behavior after the working day ended. This bout was excluded as it did not end during the working day. An average difference of 5 min between working time reported in the diaries and the sum of OSB bouts and OPA was observed and was not expected to affect the outcomes, as 5 min is only a small part of the average workday (7.8 h).

Conclusion

In conclusion, our study revealed that long bouts of OSB relative to the other OSB bouts and OPA were associated with a lower NFR. This suggests that extended OSB bouts may indicate fewer interruptions from work tasks, subsequently reducing the necessity for post-work recovery. Hence, it is important to assess the effect of interventions, such as dynamic workplace solutions, on OSB bouts, OPA and NFR. Additionally, results from this study imply the need to consider different bout lengths of OSB. To gain insight in the causal relation between different bout lengths of OSB and NFR and the role of the occupational setting and work tasks, longitudinal studies with larger sample sizes are required.

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Appendices

Appendix 1

File A1. Formulas to calculate ilr coordinates (ilr1, ilr2, ilr3) for each movement behavior, i.e. short, medium and long bouts of occupational sedentary behavior and occupational physical.

Ilr set for short OSB bouts[a] :

$$ilr_{1OSBs} = \sqrt{\frac{3}{4}}\ln\left(\frac{OSBshort}{\sqrt[3]{OSBmedium * OSBlong * OPA}}\right)$$

$$ilr_{2OSBs} = \sqrt{\frac{2}{3}}\ln\left(\frac{OSBmedium}{\sqrt[2]{OSBlong * OPA}}\right)$$

$$ilr_{3OSBs} = \sqrt{\frac{1}{2}}\ln\left(\frac{OSBlong}{OPA}\right)$$

Ilr set for medium OSB bouts[b] :

$$ilr_{1OSBm} = \sqrt{\frac{3}{4}}\ln\left(\frac{OSBmedium}{\sqrt[3]{OSBshort * OSBlong * OPA}}\right)$$

$$ilr_{2OSBm} = \sqrt{\frac{2}{3}}\ln\left(\frac{OSBshort}{\sqrt[2]{OSBlong * OPA}}\right)$$

$$ilr_{3OSBm} = \sqrt{\frac{1}{2}}\ln\left(\frac{OSBlong}{OPA}\right)$$

Ilr set for long OSB bouts[c] :

$$ilr_{1OSBl} = \sqrt{\frac{3}{4}}\ln\left(\frac{OSBlong}{\sqrt[3]{OSBshort * OSBmedium * OPA}}\right)$$

$$ilr_{2OSBl} = \sqrt{\frac{2}{3}}\ln\left(\frac{OSBshort}{\sqrt[2]{OSBmedium * OPA}}\right)$$

$$ilr_{3OSBl} = \sqrt{\frac{1}{2}}\ln\left(\frac{OSBmedium}{OPA}\right)$$

Ilr set for OPA bouts[d] :

$$ilr_{1OPA} = \sqrt{\frac{3}{4}} \ln\left(\frac{OPA}{\sqrt[3]{OSBshort * OSBmedium * OSBlong}}\right)$$

$$ilr_{2OPA} = \sqrt{\frac{2}{3}} \ln\left(\frac{OSBshort}{\sqrt[2]{OSBmedium * OSBlong}}\right)$$

$$ilr_{3OPA} = \sqrt{\frac{1}{2}} \ln\left(\frac{OSBmedium}{OSBlong}\right)$$

[a] Short bouts of occupational sedentary behavior (0-10 minutes). [b] Medium bouts of occupational sedentary behavior (10-30 minutes). [c] Long bouts of occupational sedentary behavior (>30 minutes). [d] Occupational physical activity (standing, walking and light, moderate and vigorous physical activity).


9

Chapter 9

General Discussion

Aims of this dissertation

The overall aim of this dissertation was to develop and evaluate an integrated workplace health promotion program (WHPP), based on a European good practice, the Lombardy Workplace Health Promotion Network. An additional aim was to gain insight in the association between occupational sedentary behavior the need for recovery (NFR). In doing so, the following research questions, divided over three parts were answered:

Part I – The development of the integrated WHPP

- What are the barriers and facilitators for participation in and implementation of WHPPs according to employees and employers?

Part II – The evaluation of the integrated WHPP

- How was the integrated WHPP implemented in organizations, how did employees and employers experience it, and what factors hindered or facilitated the implementation?
- What is the effect of the integrated WHPP on the overall lifestyle and targeted health behaviors of employees?

Part III – Sedentary behavior and vitality

- Is there an association between sedentary behavior at work and the NFR?

Overview of the main findings

Part I – The development of the integrated WHPP

The adaptation and evaluation plan of the integrated workplace health promotion program (WHPP) were described in *chapter 2*. For this adaptation, input from Dutch employees and employers was gathered and considered. The final result of this adaptation was a Dutch integrated WHPP, consisting of a catalogue and implementation plan. Also, the criteria of the integrated WHPP were established. Organizations had to implement activities on both the individual and organizational level for at least two health behaviors within six months after the start of the implementation (i.e. the start of the study, moment of randomization). To enhance compliance and thereby effectiveness of the integrated WHPP, factors related to participation and implementation, from the perspectives of respectively employees and employers, were incorporated in the implementation plan. In doing so, in *chapter 3* the barriers and facilitators for participation in WHPPs according

to employees were studied. Data was collected by conducting peer-to-peer interviews, a method derived from citizen science, involving the target group in the process. Based on the thematic analysis, important facilitators were support from peers and supervisors and knowledge about the advantages of participation. Important barriers for participation were an unsupportive organizational culture where lifestyle is not a common topic and a lack of flexibility of work, e.g. not able to leave the workplace to participate. In *chapter 4* the barriers and facilitators for implementation of the integrated WHPP according to employers were identified by conducting focus groups. The following facilitators for implementation were identified: meeting the needs of employees, leadership involvement and involving employees in the development and implementation process. Perceived interference with employees' private lives and different and individually operating WHPP initiatives within an organization were barriers for implementation.

Part II – Evaluation of the integrated WHPP

A mixed methods process evaluation was conducted to evaluate the implementation process of the integrated WHPP in four Dutch organizations, results were reported in *chapter 5*. Although various activities were implemented, none of the organizations met the criteria of the integrated WHPP. Working group members were enthusiastic, committed and felt involved. Working groups indicated that they felt support from higher management, but a more active role of higher management could facilitate implementation to a higher extent. Results from a two-armed cluster randomized controlled trial about the effectiveness of the integrated WHPP were reported in *chapter 6*. No effect was observed on the primary outcome measure, i.e. overall lifestyle as measured by the Simple Lifestyle Indicator Questionnaire (1, 2). Regarding the secondary outcome measures, i.e. the separate health behaviors included in the catalogue of the integrated WHPP, the consumption of sugary drinks was higher in the intervention condition over time and after twelve months. The effect of the WHP activities that were implemented targeting physical activity and nutrition at both the individual and organizational level was reported in *chapter 7*. Within the 'physical activity intervention condition', including two organizations targeting physical activity at both the individual and organizational level, moderate physical activity increased over 12 months compared to baseline. On the other hand, light physical activity decreased. No differences were observed within the 'nutrition intervention condition' including one organization that targeted nutrition at both the individual and organizational level. No differences for physical activity and nutrition between the intervention conditions and the control condition were observed.

Part III – Occupational sedentary behavior and vitality

The association between device-based occupational sedentary behavior and the NFR was studied in *chapter 8*. Results showed an association between more time spent in long bouts of occupational sedentary behavior, i.e. >30 minutes, in relation to other movement behaviors, i.e. short bouts of occupational sedentary behavior (0-10 minutes), moderate bouts of occupational sedentary behavior (10-30 minutes) and occupational physical activity (standing, physical activity), and a lower NFR. In other words, employees who spent more time in long bouts of occupational sedentary behavior compared to other movement behaviors, had a lower NFR. No associations were found for short- and medium occupational sedentary behavior bouts and occupational physical activity with NFR.

Findings in a broader perspective

A healthy lifestyle for a healthy working life

In the past years, there is an increasing focus on improving health through the pathway of a healthy lifestyle in research, healthcare practice and policy (3-8). A variety of studies, for instance about the effect of a healthy lifestyle on diabetes and cardiovascular diseases have been conducted (3-6). Within the healthcare practice a Dutch Hospital introduced the 'Lifestyle Front Office' where patients are referred to when they might benefit from lifestyle improvements (7). Moreover, since 2019, insurers in the Netherlands have reimbursed the combined lifestyle intervention. This intervention helps individuals with overweight or obesity to achieve and maintain a healthy lifestyle, with the support of healthcare professionals like physiotherapists, dietitians, and lifestyle coaches. General practitioners are involved as well and determine eligibility for the combined lifestyle intervention (9). Among general practitioners there also is a growing attention for lifestyle medicine, which includes the treatment and adjustment of all symptoms that are directly or indirectly related to lifestyle (8). By implementing the National Prevention Agreement (NPA) and the Healthy & Active Living Agreement (GALA), the Dutch government also addresses the promotion of a lifestyle of the Dutch population (10, 11). Additionally, the Action Plan 'Nederland Beweegt', a plan that aims to create the right conditions to encourage physical activity throughout the day (including a healthy living environment), especially for those who are not active enough, i.e. not meeting the physical activity guidelines, will be evaluated. One of the aims of this evaluation is to gain insight in to what extent physical activity is included in national policies and if it is implemented (12). However, a recent report indicated that, in general, the Dutch population is willing to improve their lifestyle, but they do not want the

government to impose it (13). Non-regulatory strategies, such as reducing prices for healthy nutritional products and increasing prices for unhealthy nutritional products, are generally well accepted. In this report, 24% of the Dutch working population agrees that the employer plays a role in improving physical activity (13). The workplace has not yet been clearly incorporated into the NPA and GALA. Including the workplace into these agreements, as a relevant context to stimulate a healthy lifestyle, might help to generate a sense of urgency within organizations to develop healthy workplaces and promote a healthy lifestyle among a substantial group of the population. This may also contribute to an organizational culture in which attention for a healthy lifestyle of employees is the standard and not the exception.

Health and lifestyle at the workplace

Although health promotion at work is not yet incorporated in national policy, prevention has been given a more significant role in the Occupational Health and Safety Act since 2017 (14, 15). Prevention also encompasses attention to lifestyle, such as advice given after a periodic occupational health examination (PAGO) (16). In this, WHPPs can be used to promote healthy lifestyle behaviors of employees. Still, WHPPs, including the integrated WHPP under study in this dissertation, often show small or no effect on targeted health behaviors or overall lifestyle of employees (17-19). This raises questions such as, what can we expect from WHPPs regarding sustained changes in lifestyle behavior? And what is necessary to improve lifestyle through workplace health promotion? Organizational preconditions and implementation strategies might be pivotal in these matters.

Organizational preconditions

Organizational preconditions include 1) that higher management, e.g. the board of directors, recognizes their responsibility in creating a healthy workplace, 2) formalization of actions towards a healthy workplace in policy and 3) creating an organizational culture in which attention for lifestyle at work is the standard. Higher management or supervisors do not feel responsible to improve the lifestyle and health of their employees when they believe that employees are fully responsible for their own health. They can perceive WHPPs as interfering with the private lives of employees (20-25). According to van Berkel et al. (2014) employees indeed see their lifestyle as their own responsibility, i.e. making their own choices regarding lifestyle. They do feel however, that their lifestyle choices are affected by for instance their work, and that the employer is responsible for a healthy working environment, which is in line with our findings (24). Well-defined organizational policies regarding WHP can contribute to for instance the availability of sufficient time and budget to implement WHPPs. Additionally, implementation tasks can be considered formal

tasks, and a project manager can be appointed. When implementation tasks are not considered formal tasks, as was the case in the integrated WHPP under study, these tasks are an addition to the regular work of implementers. As regular work is often prioritized, implementers perceive a lack of time to implement WHPPs. The prioritization of work tasks over implementation of or participation in WHPPs is related to the organizational culture, which is reported to be an important factor in the implementation in this dissertation and in other scientific literature (21, 26-30). A positive attitude and active participation in WHPPs, i.e. leading by example, of supervisors and higher management can positively affect the organizational culture (21-23, 29, 31, 32). Moreover, Akerstrom et al. (2024) indicated that good anchoring and participation from higher management, i.e. supporting and including WHP in the mission, vision and values of the organization, were difference-making factors in the implementation of WHPP, i.e. a factor that was necessary for successful implementation (33). In this dissertation, support from higher management was perceived as a facilitator for implementation by the working groups. However, higher management did not yet occupy an active role in the implementation. The involvement of higher management in the implementation of WHPPs is considered to be crucial, as they possess the capability and responsibility to formulate strategies and establish the organization's mission and vision, in which WHP can be incorporated (21).

Implementation strategies

Implementation strategies are important for successful implementation and sustainability of WHPPs in organizations (34-36). These implementation strategies can involve the engagement of stakeholders within the organization, i.e. higher management, supervisors and employees (20, 21, 23, 35, 37, 38). The role of higher management and supervisors in creating a supportive organizational culture has been emphasized earlier. To improve implementation, employees can be deployed as ambassadors and/or be involved in the development of the WHPP (26, 39-44). Ambassadors, i.e. enthusiastic employees that actively promote WHPPs, and peer support among employees are known to positively affect implementation (20, 28, 35, 38, 45, 46). Engagement of employees in the development of WHPPs, i.e. co-creation, and incorporating their input and knowledge, can attribute to readiness for change, commitment and WHPPs tailored to the needs of employees (40, 42-44, 47, 48). In addition to the content of a WHPP meeting the needs of employees, the timing of activities is also of importance. Since a lack of time is a frequently mentioned barrier for participation, which also came forward in results from this dissertation (49-51). Results from this dissertation, other scientific literature and the growing attention for participatory approaches and citizen science in general

underline the importance of engaging the target group (41, 42, 47, 48). In the Work towards Vitality study, engagement of employees was addressed by the working group who was responsible for the implementation of activities. Although the working group was a valuable component of the integrated WHPP, results indicated that involvement appeared to be limited to the working group and did not expand beyond. Hence, to adequately prepare working group members as ambassadors, they may require a training to educate them about their position as role models and train their communication skills (31, 44, 52-55).

Two approaches similar to the integrated WHPP are the Healthy School program and LWHPN, on which the integrated WHPP is based (56-58). These approaches are broadly implemented in schools and organizations, respectively, and also offer insights into successful implementation elements. While the two approaches are similar in content to the integrated WHPP in this dissertation, i.e. a focus on both the individual and organizational level and involvement of the target group, various differences regarding the implementation can be observed and may explain differences in effect. (56, 59-65). First of all, financial implementation support could be used to appoint an internal project coordinator with sufficient time dedicated to the project for schools or organizations that participated in respectively the Healthy School program and LWHPN, but not in the integrated WHPP under study. Secondly, collaboration between organizations in implementing activities, or making adjustments to the working environment was stimulated in the LWHPN. Thirdly, a vignette as an incentive to ensure continuity and encourage policy development could be obtained in the Healthy School program and LWHPN. To improve implementation and subsequently effectiveness of future WHPPs, these implementation elements should be considered.

The need for a total worker health program

In a review of Dieker et al. (2018) it was reported that one-fifth of the socioeconomic health inequalities is explained by lifestyle factors and one-third is explained by work factors, i.e. physical and psychosocial working conditions (66). This highlights the importance of targeting both lifestyle and working conditions to impact the lifestyle and health of employees. These factors are combined in the so-called Total Worker Health (TWH) program, a strategy that integrates health protection to prevent worker injury and illness and health promotion to improve health and wellbeing (67). This overarching approach also aims to address the disconnectedness in creating a healthy workplace, where health protection and promotion are often still treated separately (67). Results from a systematic review conducted by Anger et al. (2015) indicate that TWH interventions improve the

health of employees effectively and more rapidly compared to interventions targeting either health protection or health promotion (68).

To summarize, establishing the necessary organizational preconditions and ensuring adequate implementation might increase the effectiveness of integrated WHPPs in improving the targeted health behaviors. Moreover, translating the integrated WHPP towards a TWH approach by incorporating working conditions, may increase the impact on the health of employees by creating a healthy workplace.

The future healthy workplace

Our society has been changing due to technological innovations that make life easier, such as motorized transport, artificial intelligence and rapid changes in communication through internet, computers, and cell phones (69-72). However, these innovations also have a downside, as they can lead to adverse health outcomes. For instance, the increase in motorized transport has led to a decrease in physical activity (71, 73). Other developments, driven by technological innovations, also contributed to reduced physical activity and higher levels of sedentary behavior, such as television viewing, smartphone usage and computer work (74). There has been a substantial shift towards more office (computer) work (75). In the past ten years, the percentage of Dutch employees in physically demanding jobs has decreased while screentime at work has increased (76). Moreover, work stress increased due to performance pressure, an aging population and the increasing demand for informal care. This trend is expected to increase even further in the coming years (77). Additionally, the recent COVID-19 pandemic changed the work setting, as employees were instructed to work from home as much as possible (78, 79). In 2019, one third of Dutch employees worked from home for six hours per week, in 2020 nearly half did so for 29 hours, and by 2023 hybrid working became the norm with an average of 20 hours per week (80).

New developments bring new work-related health risks

Some innovations are promising in improving health, such as activity trackers or online interventions or apps to decrease (occupational) sedentary behavior (81-83). Other innovations pose new work-related health risks which require new, suitable directions for WHPPs. To demonstrate, the amount of sedentary work has increased substantially in the past years (75). Thereby increasing the risk of physical and mental health problems (84-86). Based on the results in chapter 8, more time spent in long bouts of occupational sedentary behavior, in relation to other behaviors, is associated with a lower and thus better NFR. The long bouts of OSB may indicate fewer interruptions while performing work tasks. When tasks

are interrupted less frequently, it is more likely that they will be completed by the end of the day. This may have a positive effect on the NFR. It is recommended to gain more detailed insight in the underlying mechanisms and causal relation that explain how these long bouts of OSB are associated to a lower NFR. These insights can be applied to develop specific and effective interventions aiming to decrease OSB while maintaining a low NFR. Another recent development that affects the working conditions and health involves hybrid working. Hybrid working does have certain advantages, e.g. working efficiently and focused at home, less time spent commuting and increased flexibility, which can improve the work-life balance (77, 80, 87, 88). Nevertheless, also negative aspects of hybrid work are reported. These include decreased physical activity, increased sedentary behavior and musculoskeletal pain, less social cohesion among colleagues, more overtime and blurred work-life boundaries (79, 89-92). To reach all employees, including hybrid workers WHPPs need to be tailored to this large group of employees. Within the integrated WHPP under study in this dissertation, the catalogue included activities that could be implemented in the 'home office' as well. Examples are providing resources reduce sitting, or tips for the work-life balance while hybrid working. In future WHPPs, more activities specifically targeting hybrid workers and their work-related health risks and implementation strategies to reach them should be included. Insights from new studies in reaching and involving hybrid workers can enhance future implementation of (integrated) WHPPs. An example is the Click2Move study, an online intervention that aims to decrease sedentary time in hybrid workers (93). Such interventions could be included in the catalogue of the integrated WHPP to improve the lifestyle of hybrid workers.

Absenteeism due to stress-related illness is one of the most common disease-specific causes in the Netherlands (94). Psychosocial stressors at work, including high work pressure contribute to this (95, 96). Hence, mental balance as a health behavior should be addressed adequately in WHPPs. Several WHPPs targeting mental balance have been studied. Most of these interventions focus on the individual employee, for instance by providing a mindfulness training (97). Several mindfulness interventions have proven to be effective in reducing stress and improving wellbeing (97). However, they cannot mitigate the high psychosocial demands. To further reduce stress and improve wellbeing, WHPPs should aim to improve psychosocial working conditions, such as low job control, high job demands or a lack of social support, in an attempt to create a mentally healthy workplace (98). This again stresses the need for a TWH approach. When higher management continuously prioritizes productivity over employee health, it influences employee behavior and can negatively impact working conditions and

mental balance, making it essential and thus recommended for WHPPs to focus on both the organizational and individual level. This is also the case for other health behaviors, such as sedentary behavior. Just knowing about the adverse health effects of sedentary behavior is not sufficient to adjust behavior if the workplace is completely designed for sedentary work. In the future healthy workplace, WHPPs that consider new ways of working and target relevant health behaviors, i.e. based on needs of employees and existing work-related health risks, on both the individual and organizational level are implemented.

Methodological considerations

The following section addresses the methodological issues of the studies in this dissertation that should be taken into account in the interpretation of the findings.

Recruitment and sample size

Recruitment of organizations

In total, four different organizations in various sectors participated in the effect- and process evaluation. Ideally a larger number of organizations was included, both to increase the number of participants and to reach a broader range of employees. A small number of participants was included in the study, i.e. the a priori calculated sample size was not met. This led to a reduced power which may have been a factor in the observed lack of effect. As the recruitment largely took place before and during the COVID-19 pandemic, the recruitment of multiple organizations in various sectors and specific sectors, for example the health care sector, failed. Due to the substantial rise in patients, and the consequent shortages in materials and personnel, hospitals' priorities at the time were not directed towards participating in research or implementing an integrated WHPP. Moreover, in another organization that had agreed to participate in the study, the workforce had substantially decreased during the COVID-19 pandemic, making participation no longer possible. Similarly, other organizations that had planned to participate had different priorities during and due to the COVID-19 pandemic, which prevented their participation. Other reasons for organizations not to participate included a lack of time, poor timing, prioritizing other projects, project initiators within organizations that had to withdrew due to personal circumstances or a lack of personnel capacity. Additionally, the study design involving a control condition and predetermined evaluation moments were a reason that organizations decided not to participate. They either wanted to implement WHPPs for the entire workforce

or wanted to follow their own path and schedule. The participating organizations shared certain characteristics, such as predominantly employing highly educated workers engaged in physically light tasks, i.e. sedentary or standing work. Nevertheless, differences were evident in both organizational structure and culture. This contributed to the richness of the collected data and heterogeneity with regard to how the intervention was implemented and received. However, it should be acknowledged that various target groups, e.g. blue collar workers, shift workers or health care workers were not reached. This means that results from this dissertation are not generalizable to employees with more physically demanding jobs.

Recruitment of employees

Based on the sample size calculation, 264 employees had to participate to demonstrate a 10% improvement in lifestyle, as measured by the Simple Lifestyle Indicator Questionnaire (SLIQ) after twelve months of follow-up. However, at baseline 173 participants were included. A total of 42 employees (24.3%) was lost to follow up. With the number of included participants after twelve months, significant differences could possibly not be demonstrated. Previous studies indicate that healthier or more health conscious employees are more likely to participate in WHPPs offered, which can also be observed in the baseline results from the cluster-randomized controlled trial (c-RCT), i.e. the high overall lifestyle score: 7.1 on a scale of 0-10 (99, 100). On the other hand, employees with a less healthy lifestyle, i.e. employees who might benefit most from WHPPs, do often not participate (99). This affects the potential effect of WHPPs, as employees who are already healthy or health conscious might have adopted this healthy behavior without the WHPP as well. Hence, they might benefit less from such programs compared to less healthy employees (99). Within the integrated WHPP this might have contributed to the lack of effect.

Study design

Cluster-Randomized Controlled Trial

The c-RCT design, to evaluate the effectiveness of the integrated WHPP had both advantages and disadvantages. The most important reason to apply the c-RCT, is that RCTs are considered the gold standard when it comes to effect evaluations. The effectiveness of the LWHPN was evaluated in a non-randomized controlled trial. Due to the absence of an equivalent control condition, evidence is not that strong. Given the considerable challenges of executing an RCT with individual randomization in the occupational setting, especially with an intervention such as the integrated WHPP, a c-RCT serves as an appropriate alternative (101, 102).

Randomization at this group level aims to mitigate contamination between control and intervention condition (101). However, it should be noted that completely avoiding contamination is not possible, for instance when participants work at different locations, which may include both control and intervention locations.

The c-RCT design also comes with certain disadvantages. For instance, the division into two conditions, i.e. control condition (wait list) and intervention condition came with difficulties. While some organizational activities were implemented, i.e. replacement of sodas and stickers to promote taking the stairs, implementation of other activities on the organizational level was challenging. Especially adjustments of policy, as policy cannot easily, if at all, be adapted for only half of the organization. Also other organizational activities, involving structures across the entire organization could not be implemented. An example of an activity that was not implemented for that reason was the (non)reception of emails outside working hours. During the study, some of the implemented activities were available for both the intervention and control condition as it was not possible to implement them for the intervention condition only. Secondly, communication to a specific part of the organization, i.e. the intervention condition, was difficult, mostly because organizations primarily have access to organization wide communication channels. Lastly, the moral aspect played a role. Various contact persons within participating organizations expressed concerns about the perceived 'fairness' of providing activities exclusively to employees in the intervention condition. Concerns were also raised regarding the motivation of employees in the control condition to participate in future WHP activities.

Alternative designs, such as the stepped-wedge design, offer a practical way to study WHPPs. In this design, randomization happens at the cluster level, with all clusters eventually receiving the WHPP. All clusters start without the WHPP, and randomization determines when each cluster switches to receiving it. This helps address fairness concerns, as all employees will eventually benefit from the WHPP. However, challenges with implementation and communication remain (102, 103). Another option is a non-randomized study, such as a responsive evaluation, which assesses the impact of a WHPP based on organizational changes or stakeholder experiences. While this avoids fairness issues, it cannot establish causal effectiveness due to the lack of a control condition (104).

Recommendations

Recommendations for research

The absence of effect of the integrated WHPP observed in this study could be a consequence of the challenged implementation rather than actual program failure. Hence, in future studies there should be even greater emphasis on the implementation process. It is therefore recommended that preparations such as forming a working group involving HR professionals, employees, and supervisors, should be done prior to the effect evaluation. Moreover, a training to prepare working group members to facilitate implementation might be beneficial in future studies.

The integrated WHPP under study aimed to improve lifestyle of employees through implementing activities on both the individual and organizational level. Although the integrated WHPP was not found to be effective in improving lifestyle, it is expected that it can be when adequately implemented in an organization that is ready and willing to implement this WHPP. To improve the willingness of organizations to invest in the lifestyle and health of their employees, cost benefits analyses might be valuable, to gain insight in the advantages of WHPPs and the return on investment. As a next step, to further improve the health of employees, in addition to improving lifestyle, an approach that also aims to mitigate work-related health risks might be necessary, i.e. a Total Worker Health program. The Total Worker Health program has already been studied and found to be effective in improving different health behaviors, however more research towards the implementation and effectiveness of such an approach is warranted (68, 105). The integrated WHPP is an ideal basis that can be expanded towards a TWH program, for instance by adding a new type of activities or actions that aim to mitigate work related health risks to the existing catalogue.

Involvement of the target group, i.e. employees and employers, in the development and implementation of WHPP is important and feasible. Moreover, it was an important facilitator for the implementation of the integrated WHPP. Hence, citizen science, or participatory approaches are recommended to apply in future research in order to tailor strategies or interventions to the needs of employees. Within these approaches, employees and employers can provide their input regarding the development, implementation evaluation. As the suitable content of WHPPs, their implementation in the organization and relevant outcome measures might differ for each occupational setting and type of employee, e.g. hybrid worker, office worker, healthcare worker, these participatory approaches are valuable for the future development, implementation and evaluation of WHPPs.

Results from this dissertation also imply the need to study the associations and mechanisms between different durations of prolonged sitting and health outcomes such as the NFR. Further insight in these potentially varying associations can be used for the development of WHPPs targeting occupational sedentary behavior, which then can be included in the catalogue of the integrated WHPP.

Recommendations for employers

To successfully integrate WHP in the organization, the role of higher management is pivotal. They must be willing to implement WHP, take the necessary measures and provide the required resources, such as time and budget. By integrating health and vitality in the mission or vision of the organization, they can show that WHP is prioritized. Additionally, higher management and supervisors are important role models for employees and should thus lead by example to create a supportive organizational culture. To further improve implementation, a project coordinator taking the lead in WHP implementation with sufficient time allocated to the implementation, should be appointed. It is essential for organizations to allocate time for working group members to implement activities so they can prioritize this accordingly. This also applies to employees, who should be able and flexible to participate in activities. To ensure certainty and stability in this regard, these aspects can be formalized in organizational policies. Moreover, identifying and selecting ambassadors to inform and stimulate colleagues can attribute to a supportive organizational culture.

Next to the engagement of employees, employers and HR professionals, occupational physicians can be consulted by the working group about the implementation and promotion of WHP activities. Although the primary focus of occupational physicians is currently on absenteeism management, there is a rising awareness concerning their role in the prevention of diseases and health promotion(106). From this perspective, they are also key stakeholders in the implementation of WHPPs, especially when WHPPs also target work-related health risks. Currently, a study is conducted to improve the uptake of preventive tasks by occupational physicians (15). Insights from this study can be used to improve future implementation of WHPPs.

Recommendations for policy

In the Netherlands, prevention of diseases through promoting a healthy lifestyle among employees is embedded in two ministries, i.e. Ministry of Health, Welfare and Sport (VWS) and Ministry of Social Affairs and Employment (SZW). Collaboration between these ministries is required to properly prioritize this topic. This demands

sufficient support and commitment within both ministries. Both will benefit from this as it can improve employees' health and lead to economic gains through reduced absenteeism and presenteeism. A recent initiative developed with funding of both VWS and SZW, is the 'Vitaal Bedrijf' program (107). Vitaal Bedrijf serves as a platform where organizations, with a specific focus on small to medium sized enterprises, can find useful information and support for implementing WHPPs. Supporting programs at national, regional or sectoral level, with a longer-term perspective are recommended as they can support and encourage organizations in establishing WHP within the organization.

General conclusion

An integrated WHPP that targets both the induvial and organizational level is promising in improving the lifestyle of employees. However, no intervention effect of the integrated WHPP was observed in this dissertation. Although barriers and facilitators for implementation of WHPPs were identified and included in the implementation plan of the co-created integrated WHPP, the implementation of the integrated program faced various challenges. Hence, organizational changes are necessary to facilitate implementation. A sense of urgency among higher management to implement WHP, include attention for the promotion of workers health and vitality in the mission of the organization and formalize implementation tasks in organizational policies are required for successful implementation. To further impact health, an integrated WHPP also taking into account work-related health risks, as for example is done in a Total Worker Health approach, is recommended. Moreover, strong involvement of the employees and employers is essential, as it contributes to a co-created WHPP, that fits their needs and thereby increases the likelihood of a successful implementation and effect.

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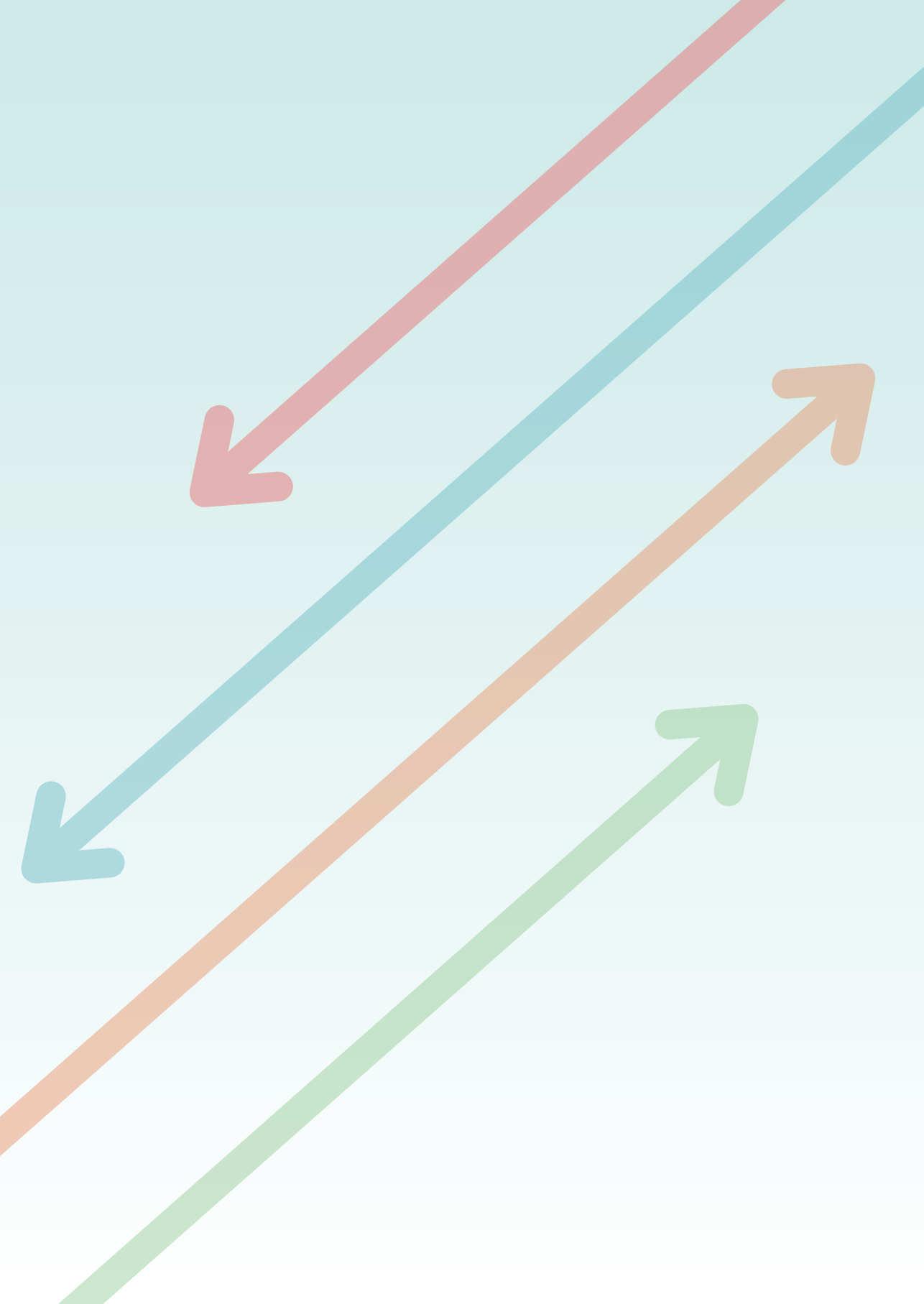

Addendum

Summary

A healthy lifestyle is essential to reduce the risk of diseases such as diabetes and cardiovascular disease. In addition, a healthy lifestyle is important for good mental health. A healthy lifestyle includes, for example, sufficient physical activity, a healthy diet, and not smoking. Healthy employees are often more productive and can generally continue working in a healthy way until retirement. Therefore, it is important for employers to focus on the health of their employees. For that reason, an increasing amount of organizations are paying attention to workplace health promotion.

Numerous workplace health promotion programs (WHPPs) have already been studied and implemented. However, most WHPPs focus solely on the individual level, in which employees, for example, receive information about a healthy lifestyle. These WHPPs targeting the individual level, influence conscious choices regarding health. But healthy behavior is also strongly shaped by nonconscious choices, often influenced by the environment. An integrated WHPP that targets both the individual and the organization (that is, the digital, social, and physical work environment, as well as policies) is potentially more effective in improving employees' lifestyles. A good example of such an integrated WHPP is the Lombardy Workplace Health Promotion Network (LWHPN). Based on promising results from a pilot study and successful implementation, the LWHPN is recognized as a European Good Practice. Organizations that participated in the LWHPN received a catalogue containing accessible activities at both the individual and organizational level, covering multiple lifestyle behaviors. Organizations developed their own WHPP by selecting and implementing activities targeting various health behaviors.

The effectiveness of a WHPP largely depends on its implementation. If the implementation does not go as planned, it can negatively affect the results. Hence, process evaluations play an important role, as they provide insights into the implementation process and help improve both the implementation and effectiveness.

Sedentary work is on the rise and has become an important health behavior in WHPPs. Prolonged sitting is associated to physical and mental health issues, such as diabetes and reduced mental well-being. Gaining more insight into the relationship between sitting and work-related outcomes can contribute to the development of WHPPs that reduce sedentary behavior, thereby having a positive effect on employees' health as well as work-related outcomes.

The aim of this dissertation is to develop and evaluate an integrated WHPP. This integrated WHPP is based on the LWHPN. An additional goal is to understand the relationship between sedentary behavior at work and the need for recovery (NFR). The following research questions were formulated and addressed, divided into three parts:

Part I - The development of the integrated approach

– What are the barriers and facilitators for participation in and implementation of WHPPs according to employees and employers?

Part II - The evaluation of the integrated WHPP

– How was the integrated WHPP implemented in organizations, how did employees and employers experience it, and what factors hindered or facilitated the implementation?
– What is the effect of the integrated WHPP on the overall lifestyle and targeted health behaviors of employees?

Part III - Sedentary behavior and vitality

– Is there an association between sedentary behavior at work and the NFR?

Part I – De development of the integrated WHPP

In *chapter 2* the development of the integrated WHPP is described. We followed a systematic approach, the Map of Adaptation Process. This process resulted in an integrated WHPP consisting of a catalogue with health-promoting activities and an implementation plan, which serves as a step-by-step guide for organizations to implement the integrated WHPP. Additionally, we established the criteria for the integrated WHPP. To meet these criteria, organizations had to implement activities at both the individual and organizational level, addressing at least two different lifestyle themes (e.g., physical activity and nutrition). We also developed a protocol for the process and effect evaluation.

The involvement of employers and employees in the development of a WHPP leads to a program that aligns with their needs and preferences. Therefore, we developed the implementation plan in co-creation with both employees and

employers. This process is described in chapters 3 and 4. In *chapter 3* the results of interviews are reported, in which employees shared their reasons for participating or not participating in WHPPs. In total, 14 employees, who received an interview training, interviewed 62 colleagues. Facilitators for participation in WHPPs included support from colleagues and supervisors, knowledge about the benefits of the activities, and previous positive experiences with participation in WHPPs. Barriers to participation included a lack of attention to health within the organizational culture and limited flexibility at work, such as being unable to leave the workplace.

In *chapter 4* the results of two focus groups involving 18 representatives from eight organizations are described. The participants shared insights into the barriers and facilitators for implementing WHPPs. Facilitators included addressing the needs of employees, offering flexible WHPPs, and co-creation with employees. Additionally, available resources, access to knowledge, and the priority given by senior management to workplace health promotion contributed to success. Barriers included the presence of multiple fragmented health initiatives and the potential interference of employers in employees' private lives. The findings from chapters 3 and 4 were used to develop the implementation plan.

Part II – The evaluation of the integrated WHPP

The evaluation of the implementation process and the effectiveness of the integrated WHPP is described in chapters 5, 6, and 7. Four organizations participated in a two-arm cluster randomized controlled trial (C-RCT). The C-RCT was conducted between January 2022 and March 2024. Within each organization, randomization took place at the cluster level, with clusters based on work locations. The intervention group consisted of 90 participants, while the control group included 83 participants.

Results from a process evaluation, embedded within the C-RCT, are reported in *chapter 5*. Data for the process evaluation were collected through questionnaires completed by 81 employees from the intervention group, workplace observations by the researchers, schedules documenting the activities implemented by working groups, and 19 individual interviews with employees, managers, and HR professionals. All organizations implemented activities at both the individual and organizational level for one health behavior. However, they did not meet the criteria of the integrated WHPP, which state that activities must be implemented at both levels for at least two different health behaviors. The process evaluation

highlighted four key themes important for the implementation process of the integrated WHPP: 1) the composition and functioning of the working group, 2) the involvement and participation of employees, 3) the role of management and policy, and 4) organizational preconditions. Each organization established a working group, whose members were motivated and enjoyed working together. The employees within the working group felt involved, but this was not always the case for employees outside the working group. The lack of organizational policy regarding workplace health promotion hindered the implementation of the integrated WHPP. All organizations expressed their intention to continue with the implementation of the integrated WHPP after the end of the study. However, sufficient time, budget, and workplace health promotion policies are necessary for this continuation.

The effectiveness of the integrated WHPP on employees' lifestyle is reported in *chapter 6*. Participants completed a questionnaire during three measurement moments: at baseline, and after six and twelve months of follow-up. The primary outcome measure was lifestyle, as measured by the Simple Lifestyle Indicator Questionnaire (SLIQ). The SLIQ consists of questions regarding five health behaviors: nutrition, physical activity, alcohol consumption, smoking, and stress. This results in a lifestyle score ranging from 0 to 10, with 0 representing the unhealthiest lifestyle and 10 representing the healthiest lifestyle possible. Employees in the intervention group had an average lifestyle score of 7.2 at baseline and 7.1 and 7.2 after six and twelve months. The control group scored an average of 7.0, 7.2, and 7.1 at baseline and after six and twelve months. There were no significant differences between the groups after six and twelve months. This indicates that the integrated WHPP did not lead to an improvement in the overall lifestyle of employees.

Two organizations succeeded in implementing activities at both the individual and organizational level for physical activity. One organization did so for nutrition. The effect of these activities on employees' physical activity and nutrition was investigated and described in *chapter 7*. Data from the C-RCT were used for this analysis. The two organizations that implemented activities at both the individual and organizational level for physical activity were classified as the 'physical activity intervention group,' which included 40 participants. Similarly, the organization that implemented activities at both levels for nutrition was classified as the 'nutrition intervention condition,' comprising 32 participants. Both intervention conditions were compared with the full control condition of the C-RCT. Within the 'physical activity intervention condition,' differences were observed in the time spent on light and moderate physical activity between baseline and follow-up (after

twelve months). Time spent on light physical activity decreased by an average of 394 minutes after twelve months compared to baseline. Time spent on moderate physical activity increased by an average of 239 minutes after twelve months compared to baseline. Within the control condition, participants had 0.7 times lower odds of consuming ≥1 sugary drink per week after twelve months compared to baseline. At the twelve-month follow-up, there were no differences between the control and intervention groups. This implies that the activities implemented at both the individual and organizational level did not affect the targeted health behaviors, namely physical activity and nutrition.

The implementation of the integrated WHPP was challenging, with most activities being minimal and with low-intensity. Moreover, the majority of activities took place one time or irregular. These factors may explain the lack of effect of the integrated WHPP.

Part III – Sedentary behavior and vitality

In *chapter 8* the results of a cross-sectional study studying the association between sedentary behavior at work and the need for recovery (NFR) are reported. In total, 89 employees with light physical work (involving a lot of sitting and standing) wore an accelerometer and completed an activity diary and a questionnaire. For this study, we conducted a compositional data analysis (CoDA). CoDA accounts for the compositional nature of various behaviors throughout a (work)day. To illustrate: a workday can be considered a closed time frame. If sedentary behavior decreases during a workday, the time spent on another behavior, such as standing or walking, logically increases during that day. CoDA analyzes the combination of behaviors as a whole instead of focusing on just one component, such as sitting alone. For this study, we included four behaviors during a workday in the composition: short (0-10 minutes), moderate (10-30 minutes), and long (>30 minutes) bouts of prolonged sitting during work and physical activity during work (including standing, light, moderate, and vigorous physical activity). The results showed that spending more time in long bouts of sedentary behavior during work, relative to other behaviors, was associated with a lower (better) score for the NFR (a decrease of 11.3 on a scale of 0-100). In other words, longer periods of sitting were associated with a lower NFR after work. Longer bouts of prolonged sitting may indicate fewer interruptions in completing work tasks. When work tasks are interrupted less frequently, there is a greater likelihood that the tasks are completed by the end of

the day. This may have a positive effect on the NFR. No other significant associations between sedentary behavior and the NFR were found.

Conclusion

In *chapter 9*, the general discussion, the key findings are summarized and placed in a broader perspective. Additionally, the methodological considerations of the study and recommendations for future research, practice, and policy are discussed. In summary, it can be concluded that the implementation of the integrated WHPP was challenging, which may have contributed to the absence of a measurable effect on employees' lifestyle. Although no improvement in lifestyle was observed, the participating organizations did make progress in workplace health promotion. Moreover, the organizations intended to continue the implementation of the integrated WHPP after the end of the study. To improve the implementation and effectiveness of WHPPs, several organizational conditions are essential. This includes the development and implementation of health promotion policies and raising awareness among higher management about their role and responsibility in creating a healthy work environment. Other important structural adjustments involve incorporating health promotion into the organization's mission and vision and allocating sufficient time and budget for WHPP implementation. Furthermore, the use of adequate implementation strategies is crucial, such as actively involving employees in the development and implementation of WHPPs.

In future studies, sufficient time and attention should be given to implementation to enhance the effectiveness of the integrated WHPP. The research design, a C-RCT, sometimes made it difficult to properly implement certain activities at the organizational level, such as policy adjustments. To further improve the impact of WHPPs on employee health, a Total Worker Health approach is recommended. This approach not only focuses on healthy lifestyle choices but also addresses work-related health risks. The integrated WHPP, as described in this dissertation, provides a solid foundation for future WHPPs. By expanding the catalogue with activities targeting work-related risks, the integrated WHPP can be further developed.

Samenvatting

Een gezonde leefstijl is essentieel om het risico op ziekten zoals diabetes en hart- en vaatziekten te verminderen. Daarnaast is een gezonde leefstijl ook van belang voor een goede mentale gezondheid. Een gezonde leefstijl houdt bijvoorbeeld in: voldoende beweging, gezonde voeding en niet roken. Gezonde medewerkers zijn vaak beter inzetbaar en kunnen doorgaans op een gezonde manier doorwerken tot hun pensioen. Voor werkgevers is het daarom belangrijk om aandacht te besteden aan de gezondheid van hun medewerkers. Steeds meer organisaties schenken daarom aandacht gezondheidsbevordering op het werk.

Er zijn al veel programma's voor gezondheidsbevordering op het werk onderzocht en ingevoerd. De meeste programma's richten zich echter alleen op het individuele niveau, waarbij medewerkers bijvoorbeeld voorlichting krijgen over een gezonde leefstijl. Deze programma's hebben invloed op bewuste keuzes rondom gezondheid. Maar gezond gedrag wordt ook sterk bepaald door onbewuste keuzes, die vaak worden beïnvloed door de omgeving. Een integrale aanpak die zich zowel op het individu als de organisatie richt (dat wil zeggen: de digitale, sociale en fysieke werkomgeving en het beleid) is potentieel effectiever in het verbeteren van de leefstijl van medewerkers. Een goed voorbeeld van zo'n integrale aanpak is het Lombardy Workplace Health Promotion Network (LWHPN). Op basis van de veelbelovende resultaten van een pilotstudie en succesvolle implementatie, wordt het LWHPN erkend als een Europese Good Practice. Organisaties die deelnamen aan het LWHPN ontvingen een catalogus met daarin toegankelijke activiteiten op zowel individueel als organisatorisch niveau voor meerdere leefstijlthema's. Organisaties stelden hun eigen programma samen door activiteiten te selecteren en te implementeren binnen verschillende leefstijlthema's.

De effectiviteit van een programma voor gezondheidsbevordering op het werk hangt sterk af van de implementatie. Als deze niet verloopt zoals gepland, kan dit de resultaten negatief beïnvloeden. Procesevaluaties spelen om die reden een belangrijke rol, omdat ze inzicht geven in het implementatieproces en daarnaast kunnen helpen bij het verbeteren van de implementatie en effectiviteit.

Zittend werk neemt toe en vormt een belangrijk leefstijlthema in programma's voor gezondheidsbevordering op het werk. Veel zitten wordt namelijk in verband gebracht met fysieke en mentale gezondheidsproblemen, zoals diabetes en verminderd mentaal welzijn. Meer inzicht in de relatie tussen zitten en werk gerelateerde uitkomsten kan bijdragen aan het ontwikkelen van programma's

die zitgedrag verminderen en daarmee een positief effect kunnen hebben op de gezondheid van de medewerkers als wel op werk gerelateerde uitkomsten.

Het doel van dit proefschrift is het ontwikkelen en evalueren van een integrale aanpak voor gezondheidsbevordering op het werk. Deze integrale aanpak is gebaseerd op het Lombardy Workplace Health Promotion Network. Een aanvullend doel is om inzicht te krijgen in het verband tussen zitgedrag op het werk en de mate van herstelbehoefte. Hiervoor zijn de volgende onderzoeksvragen opgesteld en beantwoord, verdeeld over drie delen:

Deel I - De ontwikkeling van de integrale aanpak

– Wat zijn de succes- en faalfactoren voor deelname en implementatie van programma's voor gezondheidsbevordering op het werk volgens medewerkers en werkgevers?

Deel II - De evaluatie van de integrale aanpak

– Hoe is de integrale aanpak geïmplementeerd in de organisaties, hoe hebben medewerkers en werkgevers dit ervaren en welke factoren hebben de invoering belemmerd of juist geholpen?
– Wat is het effect van de integrale aanpak op de leefstijl van medewerkers?

Deel III: Zitgedrag en vitaliteit

– Is er een verband tussen zitgedrag op het werk en de herstelbehoefte?

Deel I – De ontwikkeling van de integrale aanpak

In *hoofdstuk 2* is de ontwikkeling van de integrale aanpak beschreven. Hierbij volgden we een systematische aanpak, de Map of Adaptation Process. Dit proces leidde tot een integrale aanpak, bestaande uit een catalogus met gezondheidsbevorderende activiteiten en een implementatieplan, een stappenplan dat organisaties handvaten biedt voor de implementatie van de integrale aanpak. Daarnaast stelden we de criteria op voor de integrale aanpak. Om aan deze criteria te voldoen, moesten organisaties activiteiten invoeren op zowel individueel als organisatorisch niveau, en dit voor minstens twee verschillende leefstijlthema's

(bijvoorbeeld beweging en voeding). Ook stelden we een protocol op voor de proces- en effectevaluatie.

Het betrekken van werkgevers en medewerkers bij de ontwikkeling van een programma zorgt voor een betere aansluiting bij hun wensen en voorkeuren. Daarom ontwikkelden we het implementatieplan in co-creatie medewerkers en werkgevers. Dit proces is beschreven in hoofdstuk 3 en 4. In *hoofdstuk 3* zijn de resultaten van interviews gerapporteerd, waarbij medewerkers hun redenen deelden om wel of niet mee te doen aan gezondheidsprogramma's op het werk. In totaal interviewden 14 medewerkers, na een interviewtraining, 62 collega's. Succesfactoren voor deelname waren onder meer steun van collega's en leidinggevenden, kennis over de voordelen van de activiteiten en eerdere positieve ervaringen met deelname aan activiteiten. Belemmerende factoren voor deelname waren een gebrek aan aandacht voor gezondheid in de organisatiecultuur en beperkte flexibiliteit op het werk, bijvoorbeeld niet in staat zijn om de werkplek te verlaten.

In *hoofdstuk 4* zijn de resultaten van twee focusgroepen met 18 vertegenwoordigers van acht organisaties beschreven. De deelnemers deelden inzichten in succes- en faalfactoren voor de implementatie van gezondheidsbevorderende programma's. Succesfactoren waren onder andere het inspelen op de behoeften van medewerkers, het aanbieden van flexibele programma's, en co-creatie met medewerkers. Ook droegen beschikbare middelen, toegang tot kennis, en prioriteit die het hoger management gaf aan gezondheidsbevordering op de werkvloer bij aan het succes. Belemmerende factoren waren de aanwezigheid van meerdere losse initiatieven voor gezondheidsbevordering en de mogelijke inmenging van werkgevers in het privéleven van medewerkers. De resultaten uit hoofdstuk 3 en 4 gebruikten we om het implementatieplan verder te ontwikkelen.

Deel II – De evaluatie van de integrale aanpak

De evaluatie van het implementatieproces en de effectiviteit van de integrale aanpak zijn beschreven in hoofdstuk 5, 6 en 7. Vier organisaties namen deel aan een tweearmige cluster randomized controlled trial (C-RCT). De C-RCT werd uitgevoerd tussen januari 2022 en maart 2024. Binnen elke organisatie vond de randomisatie plaats op clusterniveau, waarbij de clusters op werklocaties waren gebaseerd. De interventiegroep telde 90 deelnemers, terwijl de controlegroep 83 deelnemers omvatte.

Resultaten van een procesevaluatie, die was ingebed in de C-RCT, zijn gerapporteerd in *hoofdstuk 5*. Gegevens voor de procesevaluatie werden verzameld via vragenlijsten, ingevuld door 81 medewerkers uit de interventiegroep, observaties door de onderzoekers op de werkplek, schema's waarin werkgroepen de ingevoerde activiteiten invulden en 19 individuele interviews met medewerkers, leidinggevenden en HR-professionals. Alle organisaties implementeerden activiteiten op zowel individueel als organisatorisch niveau voor één leefstijlthema. Ze voldeden echter niet aan de criteria van de integrale aanpak, die voorschrijft dat er activiteiten op beide niveaus moeten worden uitgevoerd voor ten minste twee verschillende leefstijlthema's. Uit de procesevaluatie kwamen vier thema's naar voren die belangrijk waren voor het implementatieproces van de integrale aanpak: 1) de samenstelling en functioneren van de werkgroep, 2) de betrokkenheid en deelname van medewerkers, 3) de rol van management en beleid en 4) organisatorische randvoorwaarden. Elke organisatie stelde een werkgroep samen, waarvan de leden gemotiveerd waren en het leuk vonden om samen te werken. De medewerkers in de werkgroep voelden zich betrokken, maar dit gold niet altijd voor medewerkers buiten de werkgroep. Het ontbreken van organisatorisch beleid met betrekking tot gezondheidsbevordering op het werk belemmerde de implementatie van de integrale aanpak. Alle organisaties hadden de intentie om door te gaan met de implementatie van de integrale aanpak na afloop van het onderzoek. Echter, hiervoor zijn voldoende tijd, budget en beleid met betrekking tot gezondheidsbevordering op het werk nodig.

De effectiviteit van de integrale aanpak op de leefstijl van de medewerkers is gerapporteerd in *hoofdstuk 6*. De deelnemers aan het onderzoek vulden drie keer een vragenlijst in: bij de start (nulmeting), en na zes en twaalf maanden. De primaire uitkomstmaat was leefstijl, gemeten met de Simple Lifestyle Indicator Questionnaire (SLIQ). De SLIQ bestaat uit vragen over vijf leefstijlthema's, namelijk voeding, fysieke activiteit, alcoholconsumptie, roken en stress. Dit resulteert in een score tussen 0 en 10 voor leefstijl, waarbij 0 staat voor de meest ongezonde leefstijl en 10 voor de meest gezonde leefstijl mogelijk. Medewerkers in de interventiegroep hadden een gemiddelde leefstijlscore van 7.2, bij de nulmeting en 7.1 en 7.2 na zes en twaalf maanden. De controlegroep scoorde gemiddeld 7.0, 7.2 en 7.1 bij de nulmeting en na zes en twaalf maanden. Er waren geen significante verschillen tussen de groepen na zes en twaalf maanden. Dit betekent dat de integrale aanpak niet heeft geleid tot het verbeteren van de algehele leefstijl van medewerkers.

Twee organisaties zijn erin geslaagd om activiteiten in te voeren op het individuele en organisatorische niveau voor het leefstijlthema fysieke activiteit. Eén organisatie

deed dit voor het leefstijlthema voeding. Het effect van deze activiteiten op de fysieke activiteit en voeding van medewerkers is onderzocht en beschreven in *hoofdstuk 7*. Data van de C-RCT werden hiervoor gebruikt. De twee organisaties die activiteiten op zowel het individuele als organisatorische niveau voor fysieke activiteit implementeerden, werden beschouwd als de 'fysieke activiteit interventiegroep, die 40 deelnemers omvatte. Op dezelfde manier werd de organisatie die activiteiten geïmplementeerd had op zowel het individuele als organisatorische niveau gericht op voeding, beschouwd als de 'voedingsinterventieconditie' en omvatte 32 deelnemers. Beide interventiecondities werden vergeleken met de volledige controle conditie van de C-RCT. Binnen de 'fysieke activiteit interventieconditie' werden verschillen waargenomen in de tijd besteed aan lichte en matige fysieke activiteit tussen de nulmeting en de nameting (na twaalf maanden). De tijd besteed aan lichte fysieke activiteit na twaalf maanden nam gemiddeld af met 394 minuten ten opzichte van de nulmeting. De tijd besteed aan matige fysieke activiteit na twaalf maanden nam gemiddeld toe met 239 minuten ten opzichte van de nulmeting. Binnen de controle conditie hadden deelnemers na twaalf maanden een 0.7 keer lagere odds om ≥ 1 suikerhoudende drank per week te consumeren in vergelijking met de nulmeting. Tijdens de nameting na twaalf maanden waren er geen verschillen tussen de controle- en interventiecondities. Dit impliceert dat de activiteiten die op zowel het individuele als organisatorische niveau werden geïmplementeerd geen effect hadden op het betreffend leefstijlgedrag, namelijk fysieke activiteit en voeding.

De implementatie van de integrale aanpak was uitdagend en er werden voornamelijk minimale en laag intensieve activiteiten geïmplementeerd. Bovendien vonden de meeste activiteiten éénmalig of onregelmatig plaats. Deze factoren kunnen de afwezigheid van een effect van de integrale aanpak verklaren.

Deel III – Zitgedrag en vitaliteit

In *hoofdstuk 8* zijn de resultaten van een cross-sectionele studie naar het verband tussen zitgedrag op het werk en de herstelbehoefte gerapporteerd. In totaal droegen 89 medewerkers met licht lichamelijk werk (veel zitten en staan) een accelerometer en vulden ze een activiteitenlogboek en vragenlijst in. Voor dit onderzoek voerden we een compositionele data-analyse (CoDA) uit. CoDA houdt rekening met de compositionele aard van verschillende gedragingen gedurende een (werk)dag. Om dit te illustreren: een werkdag kan worden beschouwd als een gesloten tijdsbestek. Als zitgedrag gedurende een werkdag afneemt, neemt de tijd besteed aan een

ander gedrag, bijvoorbeeld staan of lopen, tijdens die dag logischerwijs toe. CoDA analyseert de combinatie van gedragingen als geheel in plaats van zich te richten op slechts één component, zoals alleen zitten. Voor dit onderzoek namen we vier gedragingen gedurende een werkdag op in de compositie. Dit waren korte (0-10 minuten), middelmatige (10-30 minuten) en lange (>30 minuten) periodes van aaneengesloten zitgedrag tijdens het werk en fysieke activiteit tijdens het werk (inclusief staan, lichte, matige en intensieve fysieke activiteit). De resultaten lieten zien dat meer tijd besteed aan lange periodes van zitgedrag tijdens het werk in verhouding tot de andere gedragingen, geassocieerd was met een lagere (betere) score voor herstelbehoefte (een afname van 11.3 op een schaal van 0-100). Met andere woorden, vaker langer zitten was geassocieerd met een lagere behoefte aan herstel na het werk. De langere periodes van aaneengesloten zitten duiden mogelijk op minder onderbrekingen van het uitvoeren van werktaken. Wanneer de werktaken minder vaak onderbroken worden, is de kans groter dat de taken aan het einde van de dag afgerond zijn. Dit heeft mogelijk een positieve invloed op de mate van herstelbehoefte. Er werden geen andere significante verbanden tussen zitgedrag en mate van herstelbehoefte gevonden.

Conclusie

In *hoofdstuk 9*, de general discussion, zijn de belangrijkste bevindingen samengevat en in een breder perspectief geplaatst. Daarnaast zijn de methodologische aspecten van het onderzoek en aanbevelingen voor toekomstig onderzoek, de praktijk en het beleid beschreven. Samenvattend kan geconcludeerd worden dat de implementatie van de integrale aanpak uitdagend was, wat mogelijk heeft bijgedragen aan het uitblijven van een meetbaar effect op de leefstijl van medewerkers. Hoewel we geen verbetering in leefstijl vaststelden, hebben de deelnemende organisaties wel stappen gezet op het gebied van gezondheidsbevordering op het werk. Bovendien hadden de deelnemende organisaties de intentie om verder te gaan met de implementatie van de integrale aanpak na afloop van het onderzoek. Om de implementatie en effectiviteit van programma's voor gezondheidsbevordering op de werkplek te verbeteren, zijn verschillende organisatorische randvoorwaarden essentieel. Dit omvat het ontwikkelen en implementeren van beleid voor gezondheidsbevordering en het verhogen van het bewustzijn bij het hoger management over hun rol en verantwoordelijkheid in het creëren van een gezonde werkomgeving. Andere belangrijke structurele aanpassingen zijn het opnemen van gezondheidsbevordering in de missie en visie van de organisatie en het reserveren van voldoende tijd en budget voor de implementatie van de programma's.

Verder is het inzetten van adequate implementatiestrategieën van belang, zoals het actief betrekken van medewerkers bij de ontwikkeling en implementatie van programma's.

In toekomstige studies is voldoende tijd en aandacht voor implementatie nodig om de effectiviteit van de integrale aanpak te verbeteren. Het onderzoeksdesign, een C-RCT, maakte het soms lastig om bepaalde activiteiten op het organisatorische niveau, zoals beleidsaanpassingen, goed in te voeren. Om de impact van programma's voor gezondheidsbevordering op het werk op de gezondheid van medewerkers verder te verbeteren, wordt een Total Worker Health aanpak aanbevolen. Deze Total Worker Health aanpak richt zich niet alleen op gezonde leefstijlkeuzes, maar ook op werk-gerelateerde gezondheidsrisico's. De integrale aanpak, zoals beschreven in dit proefschrift, biedt een stevige basis voor toekomstige gezondheidsprogramma's op het werk. Door de catalogus van activiteiten uit te breiden met activiteiten die gericht zijn op werk gerelateerde risico's, kan de integrale aanpak verder worden ontwikkeld.

PhD portfolio

Name PhD student:	Denise Smit
PhD period:	May 2020 – May 2024
Names of PhD supervisor(s) & co-supervisor(s):	Prof.dr. Karin Proper Dr. Sandra van Oostrom Dr. Josephine Engels

1. PhD training

	Year	ECTS
General courses		
Research Integrity Course	2021	2.00
Presenting and pitching your research in English	2021	2.00
BROK course	2021	1.50
Specific courses		
Systematic reviews and meta-analysis	2023	0.64
Mediation analysis	2023	0.86
Stat-R course	2022	0.30
Start-R course	2022	0.30
Multilevel models and longitudinal data analysis	2022	4.00
Regression techniques	2021	5.00
Epidemiological research: basic principles	2021	4.00
Qualitative analysis	2020	0.50
Presentations		
Oral presentation at the ICOH conference	2024	
Poster presentation at the ICOH conference	2024	
Oral presentation at the ISBNPA conference	2023	
Oral presentation at the Wellbeing at work conference	2022	2.00
Poster presentation at the ICOH conference	2022	2.00
Oral presentation at the Bedrijfsgeneeskundige Dagen	2022	1.00
Oral presentation at the EPICOH conference	2021	2.00
Other		
Monthly journal club	2020-2024	1.00

2. Teaching

	Year	ECTS
Tutoring, Mentoring		
Health@Work tutor (BSc Health Sciences)	2020	1.00
Health@Work tutor (BSc Health Sciences)	2022	1.00
Supervising		
Bachelor student (Health Sciences)	2021	1.00
Master student (Human Movement Sciences)	2023	1.00
Total number of ECTS credits		33.10

List of publications

Included in this thesis

Smit DJM, van Oostrom SH, Engels JA, van der Beek AJ and Proper KI (2022) A study protocol of the adaptation and evaluation by means of a cluster-RCT of an integrated workplace health promotion program based on a European good practice. BMC Public Health 22, 1028. https://doi.org/10.1186/s12889-022-13352-0

Smit DJM, Proper KI, Engels JA, Campmans JMD and van Oostrom SH (2023) Barriers and facilitators for participation in workplace health promotion programs: results from peer-to-peer interviews among employees. Int Arch Occup Environ Health 96, 389–400. https://doi.org/10.1007/s00420-022-01930-z

Campmans JMD, **Smit DJM**, van Oostrom SH, Engels JA and Proper KI (2023) Barriers and facilitators to the implementation of workplace health promotion programs: Employers' perceptions. Front. Public Health 10:1035064. doi: 10.3389/fpubh.2022.1035064

Smit DJM, van Oostrom SH, Engels JA, Mooren-van der Meer S and Proper KI (2024) The implementation of an integrated workplace health promotion program in Dutch organizations - A mixed methods process evaluation. PLoS ONE 19(11): e0308856. https://doi.org/10.1371/journal.pone.0308856

Smit DJM, van Oostrom SH, Engels JA and Proper KI (2024) The effect of an integrated workplace health promotion program on health behaviors targeted after 12 months: Results of a cluster randomized controlled trial. Applied Ergonomics, Volume 121, 104362, ISSN 0003-6870, https://doi.org/10.1016/j.apergo.2024.104362.

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Submitted

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