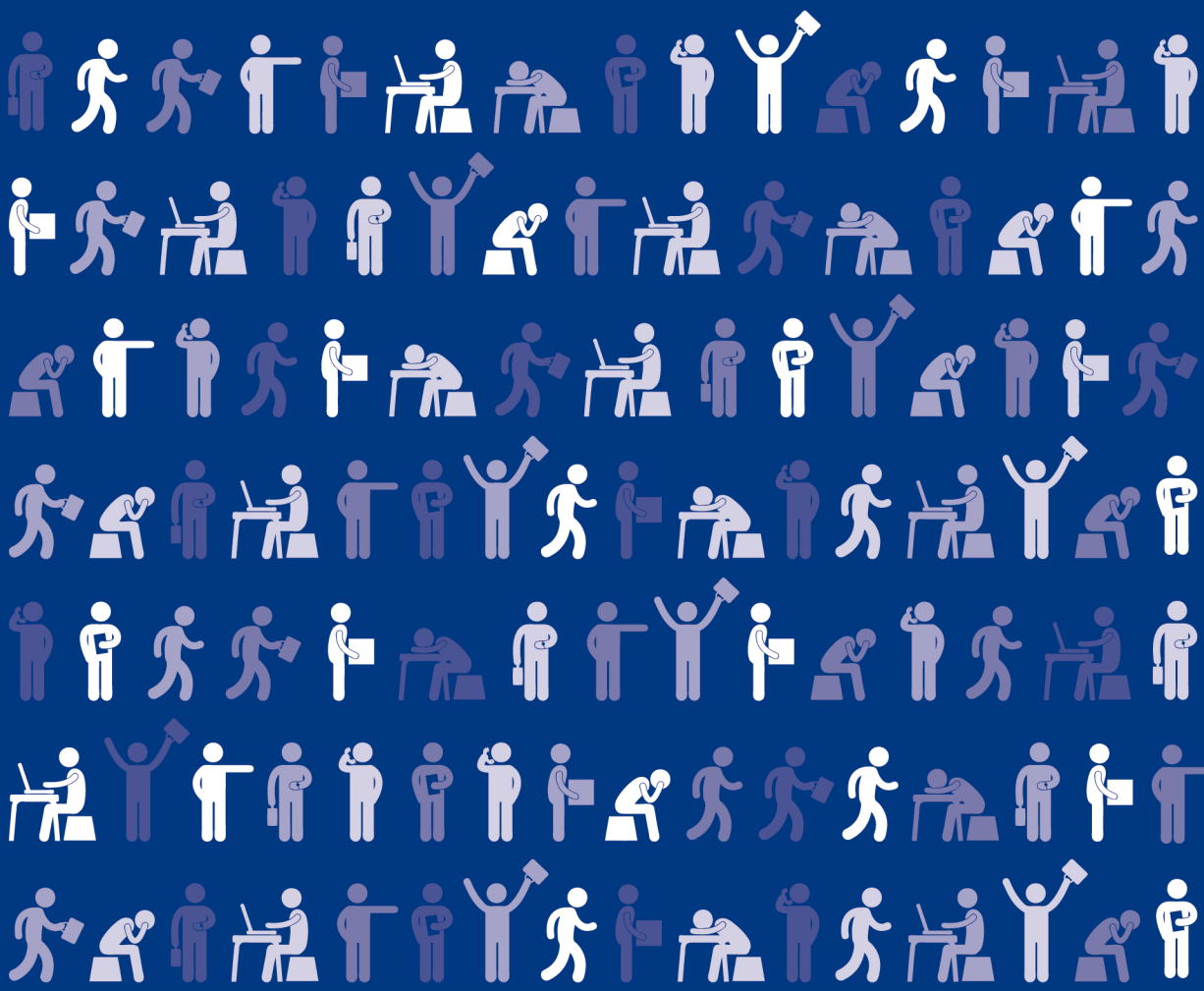

Workplace health promotion: participation and effects

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Workplace Health Promotion: Participation and Effects

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1 General introduction

BACKGROUND

Lifestyle factors are an important determinant of health.[1] The prevalence of unhealthy lifestyle behaviours is high, most notably low physical activity and poor nutrition (e.g. low fruit and vegetable consumption and high saturated fat intake). In the Netherlands, 56% engage in sufficient physical activity, that is at least 30 minutes of moderate or vigorous physical activity on at least five days per week.[2] Less than 10% of the young adults have a daily intake of at least 200 grams of fruit and 200 grams of vegetables.[2] An estimated 4.1% of the burden of disease can be assigned to physical inactivity, 2.4% to insufficient fruit intake, and 1.4% to insufficient vegetable intake.[3] The imbalance between physical activity and nutrition is an important cause of overweight and obesity, which in turn is an important risk factor for chronic diseases.[4] Individuals with overweight or obesity loose on average respectively 2.1 and 5.1 healthy life years, which is 0.9 and 0.6 healthy life years on population level.[2]

Because an unhealthy lifestyle is a major modifiable risk factor, lifestyle behaviour changes are of great importance. Therefore, a whole range of health promotion initiatives aimed at a healthy lifestyle is offered.

Workplace health promotion

Workplaces have specific features that make them a promising place for health promotion. A lot of employers offer health promotion programmes to their workers, and it has been estimated that over 80% of the companies with 50 or more employees and almost all large employers offer some kind of health improvement programme.[5] The workplace offers an efficient structure to reach large groups and a natural social network can be used.[6-7] However, several factors have been identified as great risks for ineffective workplace health promotion programmes: (1) a low, selective participation, (2) lack of adherence to the programme, and (3) an intervention period too short for sustainable behaviour change.[6,8-10] In systematic reviews positive effects of workplace health promotion programmes on lifestyle were found, but effect sizes were often modest, with e.g. less than 0.5 kg/m^2 decrease in body mass index.[11-12] However, another systematic review did not find positive effects of workplace health promotion programmes.[6] In several studies evaluation periods were too short to determine the sustainable impact, and the quality of the studies was often limited, e.g. lacking a control group.[9] Therefore, long-term studies on workplace health promotion are needed that counteracts the main factors for ineffectiveness.

Lifestyle, health and indirect costs

A societal challenge is the need to keep the ageing workforce healthy and productive. For employers it is important to influence productivity loss at work and sick leave. A lot of employers offer health promotion programmes to their workers, because a healthy worker is assumed to increase work performance. Previous studies have reported on relations between

determinants of productivity loss at work and sick leave. Ill health has been found to be an important determinant of productivity loss at work and sick leave.[13-16] In addition, systematic reviews have reported increased risks for sick leave among obese individuals.[17-18] However, the relation between health-related behaviours and sick leave or productivity loss at work is less clear. A few intervention studies have reported on the effects of health promotion activities on work productivity. In a systematic review, limited evidence was found for the effectiveness of physical activity interventions in the workplace regarding sickness absence, with no evidence for productivity loss at work.[19]

Another societal challenge is to reduce socioeconomic inequalities in health. In Europe, men and women with a low socioeconomic status are respectively 3.4 and 2.9 times more likely to report a poor health compared with individuals with a high socioeconomic status.[20] In addition, employees with a low educational level are 1.9 times more likely to have a sick leave duration of more than three days than higher educated employees.[21] However, little is known on the role of lifestyle- and work-related factors in explaining these educational differences in productivity loss at work and sick leave. There is some evidence that a part of the relation between lower socioeconomic status and sick leave can be explained by physical working conditions and a low job control,[22-24] and by lifestyle factors as smoking and overweight.[22]

Internet-delivered interventions

Internet-delivered behaviour change programmes have the potential to reach a large population at relatively low costs. However, low participation levels and high levels of attrition are often observed in these programmes.[25-28] The workplace could be a setting suitable for reaching and retaining large numbers of people, but little is known about the reach and use of Internet-delivered health promotion programmes in this setting. Researchers have highlighted the need to examine which elements of Internet-delivered programmes increase participation and reduce attrition.[29-31] In 2006, potential users of a website to promote physical activity were asked for their preferences concerning these programmes: computer-tailored advice, contacts with professionals or peers, self-monitoring, and frequent e-mail or text messages were mentioned as attractive website functionalities for a website to promote physical activity.[32]

At the start of the study presented in this thesis, there was no conclusive evidence which specific intervention elements are effective in internet-delivered studies. However, there were indications that Internet-delivered interventions may be effective in improving physical activity, healthy nutrition and weight reduction.[27,30-31,33-34] A systematic review reported small but significant short-term effects of computer-tailored education on health-related behaviour.[33,35]

Participation in workplace health promotion

Research has thus far mainly focused on the efficacy of interventions. There are however, several reasons to also investigate reach and participation in these programmes. Firstly, the characteristics of the target population and the proportion of the population that enrols in the offered intervention might influence the effectiveness of workplace health promotion. Selective participation may explain the contradictory results thus far presented on the effectiveness of workplace health promotion programmes.[6,9-10] Secondly, low participation will result in low cost-effectiveness. Participation levels in workplace health promotion vary widely across studies, from 8% to 97%.[8] It has been shown that studies with higher programme utilization tend to have better behaviour change outcomes.[27,29] The RE-AIM framework (Reach, Effectiveness, Adoption, Implementation and Maintenance) stresses the importance of insight into the reach and representativeness of the study sample. In the first step of this framework it is questioned whether enough consideration is given to the representativeness of study participants. Insight in participation levels, and in determinants of initial and sustained participation, provide important information concerning the generalizability of study results. In addition to determinants of participation in health promotion programmes, there is also a need to assess whether participants obtain sufficient exposure to relevant programme content.[36]

Another issue that might be related to participation in workplace health promotion are moral considerations of employees towards health promotion in the workplace setting. These considerations may play a role in employees' choice to participate in a health promotion programme offered by the employer. There is discussion whether and to what extent an employer should interfere with the lifestyle and health of their employees. In this context little information is available on the opinion of employees regarding workplace health promotion. However, in online discussion forums (e.g. forums on human resource management) there are discussions concerning to what extent employers should be involved in employees' lifestyle and health.

OBJECTIVES OF THE THESIS

With a whole range of Internet-delivered health promotion programmes offered in workplaces it is important to get not only insight into the effects of such programmes, but also into the reach and the use of the programmes.

The primary objectives of this thesis are:

a) To study the influence of unhealthy lifestyle, poor health, and strenuous working conditions on productivity loss at work and sick leave;
b) To identify determinants of reach and participation in workplace health promotion;

c) To study the cost-effectiveness of a long-term individually tailored workplace health promotion programme with a website component.

Datasets used in this thesis

The analyses of this thesis were based on two different datasets. First, a cluster randomized controlled trial was conducted to evaluate the cost-effectiveness of a health promotion programme for employees in six companies in the Netherlands. Participants were employees from health care organizations (n=2), commercial services (n=2), and the executive branch of government (n=2). In this study 987 employees enrolled to fill out the baseline questionnaire, of which 951 met the inclusion criterion of working at least 12 hours per week for the company, and 924 completed the questionnaire on the primary outcomes of the trial: physical activity and fruit and vegetable intake. Employees not participating in the study were invited to fill out a questionnaire to get insight into their reason for non-participation and to study differences between participants and non-participants.

The second dataset is a large dataset from a company investigating the employability of the workforce in Dutch companies. Companies from a wide range of sectors participated in this study. Complete data were collected for 10,624 workers from 49 companies.

Outline of the thesis

In chapter 5 the design of the cluster randomized controlled trial (cRCT) is described, and chapter 3, 6, 7, 8, and 9 rely on data from this cRCT study.

Chapter 2 and 3 address the first objective of this thesis, i.e. to study the relation between lifestyle, health, and productivity loss at work and sick leave. Chapter 2 presents a cross-sectional study among more than 10,000 employees and investigates the relation between lifestyle and health on one hand and productivity loss at work and sick leave on the other hand. Chapter 3 presents the extent to which lifestyle, health, and work-related factors can explain educational differences in productivity loss at work and sick leave.

Chapters 4, 6, 7 and 8 address the second objective of this thesis, i.e. to identify determinants of reach and participation in workplace health promotion. Chapter 4 presents a systematic review on determinants of participation in worksite health promotion programmes aimed at physical activity and/or nutrition. Chapter 6 is focused on moral issues in workplace health promotion, and aims to identify determinants of resistance to the employer' intervening with the employees' lifestyle. Chapter 7 evaluates the use and determinants of use of the website component in the cRCT, and chapter 8 describes determinants of initial, repeated and sustained participation in the cRCT.

Chapter 9 addresses the third objective of this thesis, i.e. to study the cost-effectiveness of an individually tailored worksite health promotion programme with a website component.

Chapter 10 discusses the main research findings, methodological considerations and recommendations for practice and for future research.

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2

The role of obesity and lifestyle behaviours in a productive workforce

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ABSTRACT

Objectives This study aims to investigate the role of lifestyle factors in relation to the presence and degree of productivity loss at work and sick leave.

Methods A cross-sectional study recruited 10,624 workers in 49 companies in the Netherlands in 2005-2009. Productivity loss at work was measured on a 10-point scale indicating how much work was actually performed on the previous workday. Sick leave was measured by asking how many days in the past 12 months workers were off work due to health problems. Logistic regression analyses were applied to study the association between obesity and lifestyle behaviours and both outcome measures.

Results Obesity was associated with the presence of sick leave (OR=1.25) and prolonged duration (OR=1.55). Insufficient physical activity (OR=1.12) and smoking (OR=1.17) were also associated with the presence of sick leave. Smoking (OR=1.45), obesity (OR=1.29) and insufficient fruit and vegetable intake (OR=1.22) were associated with the degree of productivity loss at work. The combined population attributable fractions of lifestyle factors for sick leave and the higher levels of productivity loss at work were above 10%.

Conclusions Lifestyle-related factors, especially smoking and obesity, were associated with the presence and duration of sick leave and degree of productivity loss at work. More than 10% of sick leave and the higher levels of productivity loss at work may be attributed to lifestyle behaviours and obesity. Hence, primary interventions on lifestyle may have a noticeable contribution to maintaining a productive workforce.

INTRODUCTION

With ageing populations, there is a need to keep the ageing workforce healthy and productive. The American College of Occupational and Environmental Medicine moved the health agenda forward by focussing on prevention in the workplace.[1] A lot of employers offer health promotion programmes to their workers, and it has been estimated that over 80% of worksites with 50 or more employees and almost all large employers offer some kind of health improvement programme.[2] Obesity and unhealthy lifestyle behaviours are increasingly being linked with productivity loss at work and sick leave, which lead to elevated indirect costs.[3-5] Productivity loss at work due to impaired health has an impact on future sick leave and on future general health.[6-7] Health-related determinants of sick leave and productivity loss at work are well studied,[4 8-9] but the relationship with lifestyle factors is less clear.

A higher prevalence of sick leave was found among obese workers,[10-12] and obesity also predicted long-term sick leave.[13] The association between obesity and productivity loss at work is less convincing, with some cross-sectional studies reporting a positive association between obesity and productivity loss at work,[14-16] whereas other studies did not find any association.[17-18] The findings on whether workers who have a physically active lifestyle have less sick leave and higher productivity at work are inconsistent. Some studies did not find an association,[14-17] while others reported an inverse association between physical activity and sick leave[19] or productivity loss at work.[16] In a systematic review, limited evidence was found for the effectiveness of physical activity programmes in the workplace regarding sickness absence, while no evidence was found for productivity loss at work[20] For smoking and productivity loss at work, both positive[21] and negative associations[17] have been reported. Possible explanations for these contradictory findings are the differences in outcome measurements. Often studies only focus on the presence of productivity loss at work and sick leave, ignoring the level of productivity loss at work and sick leave duration. The assessment of productivity loss at work is described as an important issue to be addressed in research.[22]

It could be hypothesised that obese workers and workers with unhealthy lifestyle behaviours have longer sick leave durations and a higher level of productivity loss at work compared to workers with a healthy body weight and healthy lifestyle behaviours. In order to investigate whether lifestyle factors are associated with the presence and degree of productivity loss at work and sick leave, a large cross-sectional study among various companies in the Netherlands was conducted. This study aims to investigate: (1) the role of lifestyle factors in relation to the presence of productivity loss at work and sick leave, (2) the associations of lifestyle factors with different levels of productivity loss at work and sick leave durations, and (3) whether similar lifestyle and health factors are related to productivity loss at work as well as sick leave.

METHODS

Study population

The study population consisted of workers in 49 companies in the Netherlands in 2005-2009. Companies from a wide range of sectors participated, that is commercial services (41%), non-commercial services (37%), industrial manufacturers (18%) and construction (4%). These companies had commissioned an occupational health organization to launch a programme to investigate the work ability of their workforces and as part of this programme a questionnaire survey was conducted on lifestyle factors, health, work demands, work ability and productivity. Companies participating in this programme invited all their workers to participate. The occupational health organization sent an invitation to all eligible workers by regular mail, and provided workers with an individualised password to fill out the questionnaire on a secure website. Written informed consent was obtained from all participants at the time of enrolment. Complete data on productivity loss at work, sickness absence and lifestyle factors were collected for 10,624 workers and made available to the Erasmus Productivity Loss at Work database (EPLW database). The response varied from 9% to 95% across companies with an overall response of 57%.

Productivity loss at work

The main outcome of this study was productivity loss at work, measured with the quantity scale of the Quantity and Quality (QQ) method.[23] Respondents were asked to indicate how much work they actually performed during regular hours on their most recent regular workday as compared with normal. The quantity of productivity was measured on a scale from 0 (nothing) to 10 (regular quantity). The outcome was dichotomised so that those scoring 0-9 were classified as reporting productivity loss at work and compared with those who scored a 10. Individuals reporting productivity loss at work were further categorised into three levels (10%, 20% and ≥30% productivity loss at work corresponding to the scores 9, 8 and 0-7 on the 10-point scale).

Sick leave

Sick leave was derived from the Work Ability Index (WAI).[24] Participants were asked to indicate on a 5-point ordinal scale on how many days in the past 12 months they were not able to work due to health problems. A dichotomous variable for sick leave (yes/no) was created. Those individuals reporting sick leave in the past 12 months were further categorised into three sick leave categories: 1-9 days, 10-24 days and 25 or more days.

Lifestyle and health factors

Height and weight were collected by questionnaire. Body mass index (BMI) was calculated by dividing body weight in kilograms by the square of body height in metres and used to define subjects as normal weight (BMI <25 kg/m^2), overweight (25≤BMI<30 kg/m^2) or obese (BMI ≥30 kg/m^2). Physical activity, fruit and vegetable intake, smoking and alcohol consumption

were measured with single yes/no questions. Those who reported they were physically active for at least 30 min per day were considered to be in agreement with the recommendation on moderate physical activity.[25] Fruit and vegetable intake was defined as eating fruit and vegetables 5 days per week or more, as a proxy estimate for compliance with the guidelines for sufficient fruit and vegetable intake.[26] Smoking was assessed as current smoking status, and alcohol use as drinking 10 or more glasses per week. The number of diagnosed diseases was derived from the WAI, and measured using a list of 13 broad categories of diseases ever diagnosed by a physician, and categorised into no disease, the presence of one disease, and the presence of two or more diseases.[24]

Work demands

Work demands were estimated based on the expert judgement of the employer. Each job title in the study population was characterised as a job with primarily physically demanding activities or as a job with primarily mental tasks. This job exposure matrix was linked to job title at the individual level, and, hence, for each worker his/her job was categorised into a mentally or physically demanding job.

Statistical analysis

Descriptive statistics were used to describe the characteristics of the study population. Cohen's κ was calculated to estimate the association between sick leave and productivity loss at work. Logistic regression analyses were used to explore associations between the dependent variables presence of productivity loss at work and presence of sick leave and the independent variables individual characteristics, lifestyle and health factors and work demands. The odds ratios (OR) were estimated as a measure of association with corresponding 95% confidence intervals (95% CI). First, univariate associations were explored, and all variables that were statistically significant ($p<0.05$) in the univariate analyses were investigated in a multivariate analysis. To increase comparability between the models for productivity loss at work and sick leave, any variable with a statistically significant association with one outcome in the univariate analysis was also included in the multivariate model for the other outcome. The absence of productivity loss at work and the absence of sick leave were defined as reference categories. Second, multinomial logistic regression analyses were performed to study the associations between the individual, lifestyle and health factors, and work demands with the degree of sick leave or productivity loss at work. This analysis was restricted to employees with sick leave or productivity loss at work. The lowest levels of productivity loss at work (10%) and sick leave (1-9 days) were defined as reference categories. All analyses were carried out in 2009 with the Statistical Package for Social Sciences 15.0 for Windows. Population attributable fractions (PAFs) were calculated for significant lifestyle factors related to productivity loss at work or sick leave, using the formula PAF=Pe(OR-1)/(1+Pe(OR-1)), in which Pe is the prevalence in the study population.

RESULTS

Table 2.1 shows that 44% of subjects reported productivity loss at work during the previous workday and 56% lost at least one workday because of sick leave in the past 12 months. No association at the individual level was found between productivity loss at work and sick leave (Cohen's κ 0.07). The mean age of the study population was 43.8 years (±9.9 years), ranging from 18 to 68 years. The mean BMI of the respondents was 25.4 kg/m^2 (±3.9 kg/m^2). All lifestyle factors were inter-related, except physical activity and alcohol intake. The prevalence of the different disease categories ranged from 3% (hereditary diseases) to 77% (musculoskeletal disorders). BMI was associated with the presence of disease: 69% of normal weight workers had at least one disease, 75% of overweight workers had at least one disease, and 83% of obese workers had at least one disease. More workers in physically demanding jobs were obese compared to workers with mentally demanding jobs (13% versus 9%).

Table 2.1 Baseline characteristics of workers (n=10,624) in 49 companies

	n	%
Individual characteristics		
Female gender	4436	42
Age (years)		
<30	1011	10
30-39	2503	24
40-49	3657	34
≥50	3453	33
Lifestyle factors		
BMI <25 kg/m^2	5394	51
25-30 kg/m^2	4075	38
≥30 kg/m^2	1155	11
Insufficient physical activity	4199	40
Insufficient fruit and vegetable intake	3299	31
Smoking	2698	25
Alcohol > 10 glasses/week	1887	18
Health factors		
No disease	2892	27
Presence of 1 disease	2880	27
Presence of 2 or more diseases	4852	46
Work-related factors		
Physically demanding jobs	4959	47
Productivity loss at work	4727	44
10% productivity loss at work	1192	11
20% productivity loss at work	1695	16
30% or more productivity loss at work	1840	17
Sick leave	5975	56
1-9 days sick leave	4257	40
10-24 days sick leave	921	9
25 days or more sick leave	797	7

Determinants of the presence of productivity loss at work and sick leave

Lifestyle factors were associated with both the occurrence of productivity loss at work and sick leave (Tables 2.2 and 2.3). Obese workers reported sick leave more often than workers with a normal body weight (OR=1.27, 95% CI 1.11-1.46). No statistically significant association was found between obesity and productivity loss at work (OR=1.05, 95% CI 0.92-1.19). Insufficient physical activity was associated with productivity loss at work (OR=1.08, 95% CI 1.00-1.17) and with sick leave (OR=1.19, 95% CI 1.10-1.29) in the univariate analyses, but in the multivariate analysis remained statistically significant only for sick leave (OR=1.12, 95% CI 1.03-1.21). The presence of sick leave in the past 12 months was also associated with smoking, the presence of diseases, younger age and working in a mentally demanding job.

The presence of productivity loss at work was associated with insufficient fruit and vegetable intake, drinking 10 or less glasses of alcohol per week, the presence of diseases and younger age. The PAFs for the presence of sick leave due to obesity, insufficient physical activity and smoking were 2.7%, 4.5% and 4.1%, respectively, resulting in a combined PAF of 10.9%. The PAF for the presence of productivity loss at work due to insufficient fruit and vegetable intake was 3.9%.

Table 2.2 Univariate odds ratios (OR) and 95% confidence intervals (CI) of individual characteristics, lifestyle-related and health factors, and work demands for productivity loss at work and sick leave among workers in 49 companies (n=10,624)

	Productivity loss at work		**Sick leave**	
	OR	95% CI	OR	95% CI
Individual characteristics				
Female gender	0.92*	0.85-0.99	1.20*	1.11-1.30
Age <30 year	1.00	.	1.00	.
30-39	0.98	0.85-1.13	1.02	0.88-1.18
40-49	0.83*	0.72-0.96	0.83*	0.72-0.95
≥50	0.80*	0.70-0.92	0.70*	0.61-0.81
Lifestyle factors				
BMI <25 kg/m^2	1.00	.	1.00	.
25-30 kg/m^2	1.04	0.96-1.13	0.98	0.90-1.06
≥30 kg/m^2	1.11	0.98-1.26	1.36*	1.20-1.55
Insufficient physical activity	1.08*	1.00-1.17	1.19*	1.10-1.29
Insufficient fruit and vegetable intake	1.17*	1.08-1.28	1.04	0.95-1.13
Smoking	1.01	0.93-1.10	1.15*	1.05-1.25
Alcohol > 10 glasses/week	0.90*	0.81-0.99	0.87*	0.79-0.96
Health factors				
No disease	1.00	.	1.00	.
Presence of 1 disease	1.28*	1.15-1.42	1.58*	1.42-1.75
Presence of 2 or more diseases	1.52*	1.38-1.66	2.65*	2.41-2.92
Work-related factors				
Physically demanding jobs	1.03	0.96-1.11	0.91*	0.85-0.99

* $p < 0.05$

Table 2.3 Multivariate odds ratios (OR) and 95% confidence intervals (CI) of individual characteristics, lifestyle-related and health factors, and work demands for productivity loss at work and sick leave among workers in 49 companies (n=10,624)

	Productivity loss at work		Sick leave	
	OR	95% CI	OR	95% CI
Individual characteristics				
Female gender	0.90*	0.82-0.97	1.19*	1.09-1.29
Age (years)				
<30	1.00	.	1.00	.
30-39	0.94	0.81-1.09	0.95	0.81-1.10
40-49	0.77*	0.67-0.89	0.72*	0.62-0.83
≥50	0.73*	0.63-0.84	0.56*	0.48-0.66
Lifestyle factors				
BMI <25 kg/m^2	1.00	.	1.00	.
25-30 kg/m^2	1.02	0.94-1.11	1.01	0.93-1.10
≥30 kg/m^2	1.05	0.92-1.19	1.25*	1.09-1.44
Insufficient physical activity	1.02	0.94-1.11	1.12*	1.03-1.21
Insufficient fruit and vegetable intake	1.13*	1.04-1.23	0.97	0.89-1.06
Smoking	0.98	0.89-1.07	1.17*	1.06-1.28
Alcohol > 10 glasses/week	0.88*	0.79-0.98	0.92	0.83-1.03
Health factors				
No disease	1.00	.	1.00	.
Presence of 1 disease	1.31*	1.17-1.45	1.66*	1.49-1.84
Presence of 2 or more diseases	1.58*	1.43-1.74	2.91*	2.64-3.22
Work-related factors				
Physically demanding jobs	1.01	0.93-1.09	0.82*	0.76-0.89

* $p < 0.05$

Determinants of the level of productivity loss at work

Table 2.4 shows the multivariate associations with the level of productivity loss at work. Obesity ($OR_{30\%}$=1.29, 95% CI 1.00- 1.65) and insufficient fruit and vegetable intake ($OR_{30\%}$=1.22, 95% CI 1.04-1.43) were associated with more productivity loss at work. Smoking was associated both with 20% productivity loss at work ($OR_{20\%}$=1.25, 95% CI 1.04-1.50) and with 30% or more productivity loss ($OR_{30\%}$=1.45, 95% CI 1.21-1.73). Compared with the univariate analyses there were modest changes in these estimates (<10%) in the multivariate analysis. The combined PAF for obesity, insufficient fruit and vegetable intake and smoking increased with the degree of productivity loss at work, to 7.4% for 20% productivity loss and 18.6% for 30% or more productivity loss at work.

Table 2.4 Multivariate odds ratios (OR) and 95% confidence intervals (CI) of individual characteristics, lifestyle-related and health factors, and work demands for the degree of productivity loss at work among workers with productivity loss at work in 49 companies (n=4,727)

	20% productivity loss at work (n=1199)		**≥30% productivity loss at work (n=1700)**	
	OR	95% CI	OR	95% CI
Individual characteristics				
Female gender	1.00	0.85-1.18	1.02	0.87-1.19
Age (years)				
<30	1.00	.	1.00	.
30-39	1.08	0.82-1.41	1.17	0.89-1.53
40-49	1.18	0.91-1.54	1.18	0.90-1.53
≥50	1.33*	1.01-1.76	1.29	0.98-1.69
Lifestyle factors				
BMI <25 kg/m^2	1.00	.	1.00	.
25-30 kg/m^2	0.95	0.81-1.12	1.11	0.94-1.30
≥30 kg/m^2	0.96	0.74-1.25	1.29*	1.00-1.65
Insufficient physical activity	1.16	0.99-1.36	1.03	0.88-1.20
Insufficient fruit and vegetable intake	1.05	0.89-1.24	1.22*	1.04-1.43
Smoking	1.25*	1.04-1.50	1.45*	1.21-1.73
Alcohol > 10 glasses/week	0.84	0.68-1.02	0.83	0.68-1.02
Health factors				
No disease	1.00	.	1.00	.
Presence of 1 disease	1.06	0.86-1.30	1.11	0.90-1.36
Presence of 2 or more diseases	1.02	0.84-1.23	1.20	0.99-1.45
Work-related factors				
Physically demanding jobs	1.01	0.86-1.17	1.30*	1.12-1.51

* $p < 0.05$

Determinants of the duration of sick leave

Table 2.5 shows the multivariate associations with sick leave duration. Among obese workers, sick leaves of 10-24 days (OR_{10-24}=1.66, 95% CI 1.33-2.07) and 25 days or more (OR_{25+}=1.55, 95% CI 1.22-1.95) were more prevalent than among individuals with a normal body weight. Smoking was associated with 10-24 days of sick leave (OR_{10-24}=1.30, 95% CI 1.10-1.53), whereas drinking more than 10 glasses of alcohol per week was inversely associated with 25 or more days of sick leave (OR_{25+}=0.70, 95% CI 0.55-0.89). Except for obesity (with a decreased OR of 21% for 10-24 days of sick leave, and 27% for 25 or more days), there were modest changes (<10%) in the odds ratios of the lifestyle factors after adjustment for each other and other factors. The combined PAF for overweight, obesity and smoking was 20.3% for 10-24 days off work due to health problems, and 13.5% for 25 or more days of sick leave.

Table 2.5 Multivariate odds ratios (OR) and 95% confidence intervals (CI) of individual characteristics, lifestyle-related and health factors, and work demands for sick leave duration among workers with sick leave in 49 companies (n=5,975)

	10-24 days sick leave (n=921)		**≥25 days sick leave (n=797)**	
	OR	95% CI	OR	95% CI
Individual characteristics				
Female gender	1.03	0.88-1.21	1.37*	1.14-1.62
Age (years)				
<30	1.00	.	1.00	.
30-39	1.11	0.83-1.48	1.56*	1.11-2.20
40-49	1.20	0.91-1.59	1.66*	1.19-2.32
≥50	1.34*	1.01-1.79	1.97*	1.41-2.75
Lifestyle factors				
BMI <25 kg/m^2	1.00	.	1.00	.
25-30 kg/m^2	1.23*	1.05-1.45	1.12	0.94-1.34
≥30 kg/m^2	1.66*	1.33-2.07	1.55*	1.22-1.95
Insufficient physical activity	1.10	0.95-1.28	1.03	0.87-1.21
Insufficient fruit and vegetable intake	0.97	0.83-1.15	0.97	0.81-1.15
Smoking	1.30*	1.10-1.53	1.17	0.98-1.40
Alcohol > 10 glasses/week	0.90	0.73-1.09	0.70*	0.55-0.89
Health factors				
No disease	1.00	.	1.00	.
Presence of 1 disease	1.72*	1.33-2.23	2.78*	2.00-3.88
Presence of 2 or more diseases	2.97*	2.37-3.74	5.74*	4.23-7.78
Work-related factors				
Physically demanding jobs	1.60*	1.38-1.86	1.93*	1.64-2.26

* $p < 0.05$

DISCUSSION

Lifestyle factors as well as health factors were associated with the presence of sick leave and productivity loss at work. Obesity and smoking were associated with a higher level of productivity loss at work and with more days off work due to health problems. The combined population attributable fractions for sick leave and for a higher level of productivity loss at work due to overweight and lifestyle behaviours were above 10%.

In our study population, the prevalence of obesity among men (11.2%) was similar to the estimated prevalence of obesity in the Dutch population, but for women a slightly lower prevalence was observed (10.4% versus 12.4%). Obesity was associated with both the presence and duration of sick leave. Although it was not associated with the presence of productivity loss, within the productivity loss group relatively more obese workers than workers of normal body weight had the highest level of productivity loss. No consistent associations were found for workers with a BMI between 25 and 30 kg/m^2. Our finding that obesity was associated with sick leave is consistent with a recent systematic review concluding that there is strong evidence that these workers are at increased risk for taking sick leave.[11] Recent reviews and studies also showed more long-term sick leave in obese workers.[10-11,13] For the lifestyle

behaviours, modest associations with productivity loss at work and sick leave were found. Our results are comparable with the findings of a recent prospective study on health-related behaviour and sickness absence reporting the strongest associations for smoking and obesity.[12] The lifestyle factors were inter-related, but odds ratios for the lifestyle behaviours in the multivariate analyses were comparable with the odds ratios in the univariate analyses. More than 10% of the sick leave and higher levels of productivity loss at work can be attributed to obesity and unhealthy lifestyle behaviours. Among workers with longer sick leave durations and more productivity loss at work, lifestyle factors became increasingly important. Hence, primary interventions on lifestyle may make a noticeable contribution to maintaining a productive workforce.

There are indications that interventions can counterbalance the negative influence of lifestyle factors on sick leave. In a meta-analysis it was found that some workplace physical activity interventions can improve worksite outcomes such as sick leave.[27] In a literature review, Matson Koffman and colleagues found that employers who invested in comprehensive worksite health promotion programmes can improve cardiovascular health in employees and yielded a US$3 to US$6 return on investment for each dollar invested over a 2- to 5-year period.[28]

Although we found no association between smoking and the presence of productivity loss at work, in the multinomial analyses the association between smoking and the level of productivity loss at work was stronger for the higher levels of productivity loss at work. In the literature contradictory findings have been reported, with both positive and negative associations for smoking with productivity loss at work.[17,21] These differences could be due to focus on the presence of productivity loss at work, as shown in an earlier study of a subset of the available data,[17] versus an analysis on the degree of productivity loss at work.[21]

An important question is which employee populations benefit the most from worksite health promotion interventions targeting weight and unhealthy behaviours.[29] In this study longer sick leave duration and a higher level of productivity loss at work were found among workers with physically demanding jobs. However, for obese workers no consistent higher productivity loss at work or longer sick leave duration was found among obese workers in physically demanding jobs compared to obese workers in mentally demanding jobs (data not shown). Schulte and colleagues found several, mostly cross-sectional, studies showing an association between work-related factors such as job stress and shift work and obesity.[30] A recent study showed that workers with a BMI above 35 kg/m^2 experienced more difficulty with job-related physical tasks than participants with overweight or mild obesity.[15] Psychosocial work demands were also found to be related to lifestyle behaviours and obesity.[29] Based on the results in the current study, the prevention of unhealthy lifestyle behaviours and obesity are important in both physically and mentally demanding jobs. The modifying role of lifestyle and obesity in relationships between work-related factors and sick leave and productivity loss at work remains an interesting topic for future research.

There was no correlation between productivity loss at work and sick leave. Productivity loss at work was not measured as health-related productivity loss, but as overall productivity loss at work in order to avoid response bias. As shown in the tables, health factors were more strongly related to sick leave than to productivity loss at work. There is evidence that workers who become sick or feel a little sick, first go to work and may suffer productivity loss at work because of reduced health. This might be an explanation for the weaker associations of lifestyle and health factors with productivity loss at work compared to the same associations with sick leave.

Limitations

A major limitation of this study is the cross-sectional study design, which does not permit further explanation with respect to causality. As mentioned before, obesity was found to predict long-term sick leave.[11] For the other lifestyle factors it is difficult to judge causality. Another limitation is the reliance on self-reported productivity loss at work and sick leave, partly due to lack of instruments to measure productivity loss objectively, especially for knowledge-based occupations.[31] The method used for the assessment of productivity loss at work showed significant correlations between self-reported productivity and actual work output (r 0.48) among floor layers.[32] A disadvantage of this method is that productivity is assessed during the previous regular workday and does not take into account the expected fluctuations in productivity loss within workers across workdays. This unknown daily fluctuation will have contributed to random measurement error and, thus, attenuated the observed associations. A third limitation is the method for the assessment of work demands at job level and the assessment of weight and height. Work demands were estimated based on the expert judgement of employers and not by self-report of the employees or by a panel of expert raters. This might cause some misclassification. Both weight and height were based on self-reports, and height has been found to be over-reported by both men and women.[33] However, as Spencer and colleagues concluded, self-reported height and weight data are valid for identifying relationships in epidemiological studies.[34] A fourth limitation is the variability in response levels across companies. The response level was lower in large companies, in commercial services companies and among blue-collar workers. However, using a cut-off of 80% response, no significant differences were found in sick leave and productivity loss at work between companies with high and low response levels, and response level was also not statistically significant when included in the univariate analyses. Therefore, we think that this source of selection bias will not have influenced the results to a major extent. Finally, the definitions of insufficient fruit and vegetable intake and of alcohol use do not correspond with the current national recommendations. Since drinking one (women) or two glasses (men) of alcohol per day is most likely beneficial to health, this could be an explanation for the inverse association with the presence of productivity loss at work and with long-term sick leave. For sick leave it has been reported that sickness absence was most common among

heavy drinkers, and least common among moderate drinkers.[12] Because educational level and physical or mental job demands are closely related, we did not adjust for education level in the analyses.

In conclusion, lifestyle behaviours, and especially smoking and obesity, were associated with the presence and duration of sick leave and the level of productivity loss at work. More than 10% of sick leave and the higher levels of productivity loss at work may be attributed to lifestyle behaviours and obesity. Hence, primary interventions on lifestyle may have a noticeable contribution to maintaining a productive workforce.

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3

The role of lifestyle, health, and work in educational inequalities in sick leave and productivity loss at work

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Submitted

ABSTRACT

Objective To investigate the influence of lifestyle, health, and work conditions in the association between education and productivity loss at work and sick leave.

Methods Employees of six companies filled out a questionnaire on demographics, lifestyle, health, and work-related factors, and productivity loss at work and sick leave at baseline (n=915) and after one-year (n=647).

Results Employees with a low education were more likely to report productivity loss at work (OR=1.56, 95% CI 1.03-2.36) and sick leave (OR=1.90, 95% CI 1.21-2.99). Work conditions attenuated the association between low education and sick leave (OR=1.75, 95% CI1.09-2.81), and additional adjustment for lifestyle factors further reduced the association (OR=1.47, 95% CI 0.89-2.42).

Conclusions Work conditions and lifestyle factors explained about 23% of the association between education and sick leave. The educational differences in sick leave prompt for interventions that address behavioural aspects as well as work and lifestyle factors.

INTRODUCTION

Workers with a low education or working in lower occupational social classes have a higher risk of disability retirement and sick leave.[1-3] The mechanisms through which socioeconomic position affects these outcomes are not yet established.

A low educational level is associated with both strenuous physical and psychosocial working conditions,[4] which are determinants of both productivity loss at work and sick leave.[5-8] Strenuous working conditions might therefore contribute to educational inequalities in productivity loss at work and sick leave. The role of working conditions on the relation between educational inequalities and sick leave has been studied before. Previous studies found that a substantial part of the relation between lower occupational class and sick leave could be attributed to physical working conditions and a low job control.[9-11] Melchior and colleagues (2005) reported that 16% to 25% of the occupational class gradient in sick leave was related to adverse working conditions.[11]

The role of other factors on the relation between educational level and sick leave is less clear. An unhealthy lifestyle and poor health are also more prevalent among employees with a low education than among better educated employees,[12-14] and have also been found to be associated with productivity loss at work and sick leave.[15-22] Laaksonen and colleagues (2010) reported that smoking and overweight explained part of the relation between occupational class and sick leave,[9] but the role of lifestyle factors in potential educational differences in productivity loss at work remain largely unknown.

In summary, little is known on the role of both work-related and lifestyle factors in explaining educational differences in sick leave and particularly in productivity loss at work. In this study both work-related and lifestyle factors are analyzed to investigate their influence on the association between educational level and productivity loss at work and sick leave.

METHODS

Study design, participants and recruitment

Participants were employees from health care organizations (n=2), commercial services (n=2), and the executive branch of government (n=2), with the main occupational groups: clerical workers, financial workers, managers, nurses and nursing aides, and policemen. Within the participating companies, the study was announced through e-mail, intranet, and/or a company magazine. Three companies restricted the maximum number of participants on a 'first in' principle. Participants enrolled voluntarily in the study by visiting the study website and completing the baseline questionnaire on lifestyle factors, health, work demands, productivity loss at work, and sick leave. Subsequently, they could participate in a physical health check. One year after the baseline measurements, participants were asked to fill out

the first follow-up questionnaire. Of the 915 participants with baseline information on educational level, lifestyle factors, productivity loss at work and sick leave, 71% filled out the 1-year follow-up questionnaire (n=647). The Medical Ethics Committee of Erasmus MC, University Medical Center in Rotterdam, the Netherlands, approved the study and all participants gave written informed consent.

Outcomes

Productivity loss at work

Productivity loss at work was measured with the quantity scale of the Quantity and Quality (QQ) method.[23] This measure showed a moderate correlation with objective work output (r=0.48) among floor layers.[24] Respondents were asked to indicate how much work they actually performed during regular hours on their most recent regular workday, compared with normal. The amount of productivity was measured on a scale from 0 (nothing) to 10 (regular amount). The outcome productivity loss at work was classified into three categories: no productivity loss (score=10), 10-20% productivity loss (score=8 or score=9), and 30% or more productivity loss at work (score of 7 or lower).

Sick leave

Sick leave was derived from the Work Ability Index (WAI).[25] Participants were asked to indicate on a 5-point ordinal scale how many days in the past 12 months they were not able to work due to health problems. The outcome sick leave was classified into three categories: no sick leave, 1-9 days, and 10 days or more with sick leave.

Determinants

Individual characteristics

In the baseline questionnaire, participants were asked about their age, sex, education, and ethnicity. Educational level was assessed by the highest level of education completed and was defined as low (primary school, lower and intermediate secondary schooling, or lower vocational training), intermediate (higher secondary schooling or intermediate vocational schooling) and high (higher vocational schooling or university). Two categories were created for ethnicity: Dutch and other, according to the standardized procedures described by Statistics Netherlands.[26]

Lifestyle factors

Physical activity (PA) was measured in the baseline questionnaire by the short version of the International Physical Activity Questionnaire (IPAQ), which assessed vigorous and moderate intensity PA.[27] The average time spent on PA per day was calculated. Walking was not included in this calculation, since casual walking is regarded a light-intensity activity. For all behaviours, a dichotomous variable was calculated for non-compliance with the national

recommendations. For insufficient moderate PA a cut-off point of less than 30 minutes of PA per day was used, and for insufficient vigorous PA a cut-off point of less than three times a week vigorous PA. For insufficient fruit and vegetable intake the cut-off point was less than 400 grams of fruit and vegetables. Fruit and vegetable intake was measured with the nine-item validated Dutch Food Frequency Questionnaire.[28] Smoking was defined as current smoking status, and excessive alcohol use as drinking 15 or more glasses of alcohol per week for women and 22 or more glasses for men.

Health indicators

The first question of the Short Form-12 (SF-12) questionnaire was used to measure perceived general health and dichotomized into 'poor or moderate' and 'good to excellent'.[29] In the physical health check, height and weight were measured to calculate the Body Mass Index (BMI) and to categorize individuals as normal weight (BMI<25kg/m^2), overweight (25<BMI<30kg/m^2), and obese (BMI≥30kg/m^2). In the first follow-up, weight was self-reported in the questionnaire.

Work-related factors

Participants were asked to indicate whether their current job is mainly physically or mentally demanding. In addition, specific psychosocial and physical work demands were asked. The following psychosocial factors were measured with an abbreviated version of a validated Dutch questionnaire about psychosocial job demands on job stress: work demands (6 items, Cronbach's α=0.82), job control (4 items, Cronbach's α=0.89), skill discretion (4 items, Cronbach's α=0.78), and support from colleagues (6 items, Cronbach's α=0.74) and supervisor (6 items, Cronbach's α=0.79).[30] Questions on work demands were related to excessive work, and insufficient time to complete the work. Job control concerned influence on the planning of tasks, and influence on the pace of work. Skill discretion related to creativity, varied work, and required skills and abilities. For all questions, a four-point scale was used with ratings 'never', 'sometimes', 'often', and 'always'. A standardized sum score was calculated for each dimension separately and workers with a score in the upper quartile were regarded as exposed to the psychosocial risk factor.

Physical load in the current job concerned the regular presence of working in awkward postures, and lifting heavy loads. For both factors a four point scale was used with rating 'seldom or never', 'now and then', 'quite a lot', and 'a lot' during a normal workday. The answers 'quite a lot' and 'a lot' were classified as high exposure.[31]

Statistical analyses

Descriptive statistics were used for characteristics of the study population.

In order to study the association of the dependent variables ('10%-20% productivity loss at work' '30% or more productivity loss at work', '1-9 days sick leave', and '10 or more days

sick leave') with educational level, lifestyle-related factors, health, and work-related factors General Estimating Equations (GEE) were used. GEE is suitable for the analysis of repeated measurements within participants. The absence of productivity loss at work and sick leave were reference categories. In all models, demographic factors were considered to be time independent, and all associations were adjusted for sex, age, and ethnicity. The odds ratios (OR) were estimated as measure of association with corresponding 95% confidence intervals (95% CI). Population attributable fractions (PAFs) were calculated for statistically significant lifestyle factors related to productivity loss at work or sick leave, using the formula PAF=Pe(OR-1)/(1+Pe(OR-1)), whereby Pe is the prevalence of the lifestyle factor in the study population.[32]

In order to study the influence of lifestyle factors, perceived general health, and work-related factors on the associations between educational levels and productivity loss at work and sick leave, these factors were added separately to the basic statistical model describing the association between educational level and productivity loss at work or sick leave, adjusted for demographic confounders. All variables with an association with educational level ($p<0.20$) and a statistically significant association with productivity loss at work or sick leave ($p<0.05$) were selected to study the influence on the association between educational level and productivity loss at work and sick leave. All analyses were carried out with SAS 9.2 statistical software package.

RESULTS

Table 3.1 shows that at baseline 33% of the subjects reported productivity loss at work during the previous workday and 59% lost at least one workday because of sick leave in the past 12 months. At 1-year follow-up, 30% of the participants reported productivity loss at work, and 52% reported sick leave. Productivity loss at work and sick leave were not associated (Cohen's $\kappa=0.07$). Productivity loss at work and 10 or more days sick leave were more prevalent among low educated employees as compared to better-educated participants. Overweight and obesity and reduced perceived general health were also more prevalent among employees with a low education. Employees with a low educational level more often had physically demanding jobs and jobs with low job control than better-educated participants.

Twenty-nine per cent of the baseline participants were lost to follow-up. Individuals with insufficient fruit and vegetable intake (OR=0.65, 95% CI 0.49-0.88) and smokers (OR=0.53, 95% CI 0.37-0.75) were less likely to fill out the follow-up questionnaire than workers with a healthy lifestyle. Older employees (OR=3.01, 95% CI 1.86-4.86) were more likely to repeat participation at one-year follow-up.

Productivity loss at work

As shown in Table 3.2, participants with a low educational level (OR=1.56, 95% CI 1.03-2.36) and participants with insufficient vigorous PA (OR=1.58, 95% CI 1.11-2.27) were more likely to

Table 3.1 Baseline characteristics of participating employees in 6 companies (n=915)

	Total (n=915)		Low education (n=201)		Intermediate education (n=303)		High education (n=411)	
	n	%	n	%	n	%	n	%
Demographic factors								
Female gender	469	51%	92	46%	166	55%	211	51%
Age (years)*								
<40	376	41%	49	24%	128	42%	199	48%
40-49	274	30%	66	33%	106	35%	102	25%
≥50	265	29%	86	43%	69	23%	110	27%
Non-Dutch ethnicity	147	16%	49	24%	43	14%	55	13%
Lifestyle factors								
Insufficient moderate PA	295	32%	80	40%	85	28%	130	32%
Insufficient vigorous PA	646	71%	144	72%	203	67%	299	73%
Insufficient fruit & vegetables	429	47%	98	49%	152	50%	179	44%
Current smoker	164	18%	47	24%	49	16%	68	17%
Excessive alcohol user	24	3%	3	2%	7	2%	14	3%
Overweight*	274	30%	66	39%	95	35%	113	31%
Obese	70	8%	23	14%	25	9%	22	6%
Health indicator								
Poor/moderate health*	58	6%	21	10%	18	6%	19	5%
Work-related factors								
Physically demanding job*	145	16%	51	25%	47	16%	47	11%
Lifting heavy loads	84	9%	21	11%	28	9%	35	9%
Awkward postures	117	13%	28	14%	44	15%	45	11%
High work demands*	291	32%	56	28%	89	29%	146	36%
Low job control*	303	33%	75	37%	116	38%	112	27%
Low skill discretion	242	26%	49	24%	98	32%	95	23%
Poor relation with colleagues	263	29%	47	23%	99	33%	117	29%
Poor relation with supervisor	255	28%	49	24%	82	27%	124	30%
Outcome (at baseline)								
Productivity loss at work*	302	33%	81	40%	99	33%	122	30%
10-20% productivity loss	179	20%	49	24%	57	19%	73	18%
≥ 30% productivity loss	123	13%	32	16%	42	14%	49	12%
Sick leave	535	59%	116	58%	192	63%	227	55%
1-9 days sick leave	404	44%	78	39%	139	46%	187	46%
≥ 10 days sick leave*	131	14%	38	19%	53	17%	40	10%

* $p < 0.05$ (trend test), PA physical activity

report productivity loss at work. The strongest association was found between a poor health and productivity loss at work (OR=3.33, 95% CI 1.98-5.61). Low job control (OR=1.55, 95% CI 1.12-2.17), and a poor relation with supervisors (OR=2.13, 95% CI 1.51-3.00) or colleagues (OR=1.61, 95% CI 1.14-2.27) were also associated with productivity loss at work. A statistically significant interaction was found between insufficient vigorous PA and educational level. After stratifying for educational level, insufficient vigorous PA was only associated with 30% or more productivity loss at work among better-educated employees (OR= 3.81, 95% CI 1.73-8.41) with a PAF of 28.9%

Table 3.2 Univariate odds ratios (OR) and 95% confidence intervals (95%CI) of individual characteristics, lifestyle-related and health factors, and work-related factors in relation with productivity loss at work and sick leave among employees in 6 companies (n=647)

		Productivity loss at work				Sick leave			
	Pe	10%-20%† (n=130)		30% or more† (n=93)		1-9 days‡ (n=305)		10 or more days‡ (n=97)	
	%	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Educational level									
Low	21	1.42	0.99-2.05	1.56*	1.03-2.36	1.04	0.75-1.44	1.90*	1.21-2.99
Intermediate	35	1.21	0.88-1.66	1.29	0.88-1.89	1.28	0.98-1.69	1.87*	1.23-2.84
High	45	1.00	.	1.00	.	1.00	.	1.00	.
Lifestyle									
Insufficient moderate PA	30	1.19	0.90-1.57	1.19	0.84-1.68	0.86	0.68-1.08	0.92	0.65-1.29
Insufficient vigorous PA	70	1.08	0.81-1.44	1.58*	1.11-2.27	1.20	0.95-1.52	1.24	0.86-1.79
Insufficient fruit & vegetables	44	0.86	0.65-1.13	1.00	0.73-1.38	0.95	0.76-1.19	1.13	0.81-1.56
Current smoker	15	1.16	0.81-1.67	0.96	0.62-1.48	1.35	0.97-1.87	1.46	0.95-2.26
Excessive alcohol	3	0.65	0.28-1.53	1.01	0.39-2.61	1.04	0.49-2.21	1.50	0.64-3.52
Overweight	35	1.18	0.86-1.61	1.20	0.84-1.70	1.02	0.78-1.33	1.54*	1.02-2.32
Obese	9	1.11	0.68-1.82	0.79	0.41-1.52	0.76	0.47-1.22	2.30*	1.29-4.13
Health									
Poor/moderate health	6	1.90*	1.10-3.30	3.33*	1.98-5.61	1.84*	1.09-3.10	6.51*	3.61-11.71
Work-related									
Physically demanding job	15	1.23	0.84-1.78	1.10	0.70-1.74	1.09	0.77-1.54	1.44	0.91-2.28
Lifting heavy loads	9	1.18	0.76-1.83	0.62	0.31-1.25	1.16	0.75-1.79	0.76	0.38-1.52
Awkward postures	13	1.00	0.67-1.83	1.12	0.70-1.80	1.63*	1.11-2.39	1.93*	1.17-3.19
High work demands	31	1.18	0.76-1.58	1.08	0.75-1.55	1.24	0.95-1.62	1.22	0.83-1.80
Low job control	32	1.11	0.83-1.48	1.55*	1.12-2.17	1.52*	1.17-1.97	1.91*	1.32-2.83
Low skill discretion	27	1.30	0.95-1.77	1.35	0.94-1.92	1.51*	1.14-2.00	1.95*	1.32-2.90
Poor relation with colleagues	28	1.40*	1.04-1.89	1.61*	1.14-2.27	1.17	0.89-1.53	1.72*	1.18-2.50
Poor relation with supervisor	28	1.72*	1.28-2.31	2.13*	1.51-3.00	1.29	0.98-1.68	1.77*	1.22-2.58

* $p < 0.05$, Pe: prevalence in study population, † reference category: no productivity loss, ‡ reference category: no sick leave. Adjusted for sex, age, and ethnicity

The combination of work-related factors did not explain the association between educational level and productivity loss at work (Table 3.3). After adjustment for perceived general health the strength of the association between a low educational level and 30% or more productivity loss at work decreased from OR=1.56 to OR=1.50 (11% change). The strength of the association was not further reduced after adjustment for work-related or lifestyle factors.

Sick leave

As shown in Table 3.2, individuals with a low (OR=1.90, 95% CI 1.21-2.99) or intermediate educational level (OR=1.87, 95% CI 1.23-2.84) were more likely to have 10 or more workdays sick leave. Obesity was statistically significantly associated with more sick leave days after adjustment for gender, age, and ethnicity (OR=2.30, 95% CI 1.29-4.13). The strongest association was found between perceived general health and sick leave (OR=6.51, 95% CI 3.61-11.71). Several work-related factors were also associated with sick leave: working in awkward postures, low

Table 3.3 Effects of adjustment for work-related factors, health, and lifestyle factors on the association between educational level and productivity loss at work.

	10%-20% productivity loss at work†				30% or more productivity loss at work†			
	Low education‡		Intermediate education‡		Low education ‡		Intermediate education‡	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Model 1: sex, age and ethnicity	1.42	0.99-2.05	1.21	0.88-1.66	1.56	1.03-2.36	1.29	0.88-1.89
Model 2: model 1 + reduced perceived health	1.41	0.98-2.03	1.20	0.87-1.64	1.50	0.99-2.27	1.29	0.88-1.89
Model 3: model 1 + work-related factors[a]	1.50	1.04-2.16	1.23	0.89-1.69	1.64	1.08-2.48	1.27	0.87-1.87
Model 4: model 1 + lifestyle[b]	1.42	0.99-2.05	1.21	0.88-1.66	1.58	1.04-2.39	1.36	0.93-1.99
Model 5: model 1 + health + work factors	1.49	1.03-2.15	1.22	0.89-1.69	1.58	1.04-2.40	1.28	0.87-1.89
Model 6: model 1 + health + work factors + lifestyle	1.50	1.03-2.16	1.23	0.89-1.70	1.63	1.07-2.49	1.34	0.91-1.97

† reference category: no productivity loss, ‡ reference category: high educational level

[a] work-related factors: low job control, poor relation with colleagues and with supervisor

[b] lifestyle: insufficient vigorous physical activity

job control, low skill discretion, and a poor relation with colleagues (Table 3.2). The PAFs for overweight and obesity were respectively 15.9% and 10.5% for 10 days or more sick leave.

The combination of work-related factors partly explained the association between educational level and sick leave (Table 3.4). After adjustment for work-related factors the strength of the association between a low educational level and 10 or more days of sick leave decreased from OR=1.90 to OR=1.75 (17% change). Combined adjustment for work-related factors and perceived general health further reduced the strength of the association between a low educational level and 10 or more days of sick leave with an additional 8%. After additional adjustment for overweight/obesity the strength of the association between a low educational level and 10 or more days of sick leave further reduced with another 23% (48% change from OR=1.90 to OR=1.47).

Table 3.4 Effects of adjustment for work-related factors, health, and lifestyle factors on the association between educational level and sick leave.

	1-9 days sick leave†				10 or more days sick leave†			
	Low education‡		Intermediate education‡		Low education ‡		Intermediate education ‡	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Model 1: sex, age and ethnicity	1.04	0.75-1.44	1.28	0.98-1.69	1.90	1.21-2.99	1.87	1.23-2.84
Model 2: model 1 + reduced perceived health	1.05	0.75-1.46	1.29	0.98-1.70	1.83	1.16-2.90	1.82	1.19-2.79
Model 3: model 1 + work-related factors[a]	1.00	0.71-1.40	1.19	0.90-1.58	1.75	1.09-2.81	1.71	1.10-2.64
Model 4: model 1 + lifestyle[b]	1.02	0.73-1.44	1.28	0.96-1.69	1.74	1.08-2.81	1.78	1.14-2.77
Model 5: model 1 + work factors + health	1.04	0.74-1.45	1.22	0.92-1.62	1.67	1.04-2.69	1.66	1.06-2.60
Model 6: model 1 + work factors + health + lifestyle	0.98	0.69-1.38	1.18	0.88-1.57	1.47	0.89-2.42	1.59	0.99-2.55

‡ reference category: no sick leave, ‡ reference category: high educational level

[a] work-related factors: awkward postures, low job control, low skill discretion, poor relation with colleagues.

[b] lifestyle factors: overweight/obesity

DISCUSSION

Educational differences were found for productivity loss at work and sick leave. These educational differences in productivity loss at work and sick leave were particularly apparent in the more severe categories of productivity loss at work and sick leave. Unhealthy lifestyle factors, a poor general health, and unfavourable work conditions were also more prevalent among lower educated employees, but did not influence the association between education and productivity loss at work. Work-related factors and obesity did have an influence on educational differences in sick leave.

Previous research found educational differences in sick leave.[1-2] In our study these findings were corroborated, especially for 10 or more days with sick leave. We also found educational differences in productivity loss at work. Employees with a low educational level had a higher risk of productivity loss at work. Although productivity loss at work and sick leave were not associated, educational level was associated with both outcomes.

Unhealthy lifestyle behaviours and a decreased perceived general health were more prevalent among lower educated persons.[12-14] For productivity loss at work, these factors did not change the associations between educational levels and productivity loss at work. However, the association between sick leave and educational level decreased after adjustment for work-related and lifestyle factors. The relation between a poorer general health on one hand and productivity loss at work or sick leave on the other hand was consistent over the educational groups. In accordance with the study of Laaksonen and colleagues,[9] work-related factors and overweight/obesity had the biggest influence on the relation between educational level and sick leave. However, in the study of Laaksonen and colleagues strenuous physical work conditions instead of psychosocial work conditions provided the strongest explanation for socioeconomic differences in sickness absence. In contrast with other studies,[33-35] we did not find an association between having a physically demanding job and sick leave, nor between lifting heavy loads and sick leave. A possible explanation might be that the proportion of workers with exposure to mechanical load was low in our study population. Although 9% was exposed to lifting heavy loads in our study, only 3% answered 'a lot' on the question how often they have to lift heavy loads. This might indicate that those workers who were classified as having strenuous work conditions in our study, are not that highly exposed to the specific physical work conditions. The evidence from literature indicates that both psychosocial and physical work factors may play a role in explaining educational differences in sick leave. Therefore, interventions aimed at improving work conditions, especially job control, among lower educated employees might reduce educational differences in sick leave. However, a large proportion of the educational differences in sick leave could not be explained by these factors. Other factors, like coping strategy, social support, and motivation to work were not measured in our study, and may be relevant in explaining educational differences.[36-37]

Relations between lifestyle factors and sick leave are well-studied. In previous research a relation between obesity and sick leave was found, especially with long-term sick leave.[18,20-21,33] Concerning productivity loss at work less evidence is available on the specific role of lifestyle factors. An association was observed between insufficient vigorous physical activity and more than 30% productivity loss at work. However, this association was found only among better-educated employees. A possible explanation might be found in the role of physical activity to reduce perceived stress. Vigorous physical activity may be a method to release stress in mentally demanding jobs and thereby decrease productivity loss at work.[38] It might be an interesting topic for future research to study whether physical activity buffers the relation between job demands and productivity loss at work in different types of work.

Limitations

Firstly, participation levels differed between companies, partly because three companies had restricted the maximum participation. However, baseline participation levels (ranging from 36% to 61%) in the other companies without restrictions were comparable with other studies on health promotion programmes at the worksite, and in a systematic review no evidence was found for selective participation concerning health or lifestyle indicators.[37] Secondly, a subjective measure of productivity loss at work was used. Objective measures of productivity loss at work are rarely available, and the quantity question of the QQ method was associated with objective work output among floor layers (r=0.48). Thirdly, as we described in the results, there is selective loss to follow-up. However, no selective loss to follow-up was found in the outcome measures. Fourthly, sickness absence has a multifactorial nature. Although we adjusted for several factors in the analyses, there may be confounders which were not taken into account.

Conclusion

In conclusion, educational differences were observed in productivity loss at work and sick leave. These differences could hardly be assigned to health. Work-related and lifestyle factors did attenuate the association between low education and sick leave. These educational differences in sick leave prompt for interventions that address behavioural aspects as well as work and lifestyle factors.

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Determinants of participation in worksite health promotion programmes: a systematic review

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Int J Behav Nutr Phys Act 2009;6:26

ABSTRACT

Background The workplace has been identified as a promising setting for health promotion, and a lot of worksite health promotion programmes have been implemented in the past years. Research has mainly focused on the effectiveness of these interventions. For implementation of interventions at a large scale however, information about determinants of participation in these programmes is essential. This systematic review investigates initial participation in worksite health promotion programmes, the underlying determinants of participation, and programme characteristics influencing participation levels.

Methods Studies on characteristics of participants and non-participants in worksite health promotion programmes aimed at physical activity and/or nutrition published from 1988 to 2007 were identified through a structured search in PubMed and Web of Science. Studies were included if a primary preventive worksite health promotion programme on physical activity and/or nutrition was described, and if quantitative information was presented on determinants of participation.

Results In total, 23 studies were included with ten studies on educational or counselling programmes, six fitness centre interventions, and seven studies examining determinants of participation in multi-component programmes. Participation levels varied from 10% to 64%, with a median of 33% (95% CI 25–42%). In general, female workers had a higher participation than male workers (OR 1.67; 95% CI 1.25–2.27), but this difference was not observed for interventions consisting of access to fitness centre programmes. For the other demographic, health- and work-related characteristics no consistent effect on participation was found. Pooling of studies showed a higher participation level when an incentive was offered, when the programme consisted of multiple components, or when the programme was aimed at multiple behaviours.

Conclusion In this systematic review, participation levels in health promotion interventions at the workplace were typically below 50%. Few studies evaluated the influence of health, lifestyle and work-related factors on participation, which hampers the insight in the underlying determinants of initial participation in worksite health promotion. Nevertheless, the present review does provide some strategies that can be adopted in order to increase participation levels. In addition, the review highlights that further insight is essential to develop intervention programmes with the ability to reach many employees, including those who need it most and to increase the generalizability across all workers.

BACKGROUND

The imbalance between physical activity (PA) and nutrition is an important cause of overweight and obesity, which in turn are important risk factors for cardiovascular diseases (CVD), and other chronic diseases.[1] The World Health Organization reported that, globally, there are more than one billion overweight adults and at least 400 million obese adults.[2] In the primary prevention of obesity, a large variety of health promotion programmes are offered.

In the past decades the workplace has been identified as an important setting for health promotion, since it offers an efficient structure to reach large groups, and makes use of a natural social network.[3-4] Research has thus far mainly focused on the effectiveness of these interventions. There are, however, several reasons to also investigate participation in health promotion programmes at the workplace. Firstly, the effectiveness of a worksite health promotion programme (WHPP) will be influenced by the characteristics of the target population and the proportion of the population that enrols in the offered intervention. As such, differences in participation levels may partly explain the large differences in effectiveness of WHPPs observed.[3,5-6] Secondly, WHPPs have to deal with variable and often low participation levels.[7] This may hamper the external validity of the findings, particularly when selective groups of individuals participate in the programmes. Earlier studies addressing participation in worksite health promotion[7-10] presented participation levels varying from 8% to 97%.[7] In a review, Glasgow and colleagues (1993) reported that men, blue-collar employees, and smokers appeared less likely to participate.[9] In accordance with these findings, Dobbins and colleagues (1998) found a higher attendance in an at-work health risk assessment for women and those of higher occupational class. A lower participation was found among current or past smokers, but no differences were found for alcohol consumption, physical activity, and nutrition.[8] Thirdly, low participation will result in low cost-effectiveness.

Since the last systematic review on participation in WHPPs in 1993,[9] numerous worksite programmes aiming at physical activity, nutrition and overweight have been evaluated for their cost-effectiveness. Knowledge about programme characteristics that contribute to participation is required to increase the cost-effectiveness of the interventions, which may be crucial for companies implementing the programmes. In order to update and extent previous findings it is important to investigate (1) who are reached by means of WHPPs on physical activity and nutrition, and (2) when participation is more likely. Hence, we conducted a systematic review with the aims 1) to describe participation levels in WHPPs, 2) to evaluate underlying individual, health- and work-related determinants of participation, and 3) to analyse programme characteristics that influence participation levels.

METHODS

Identification of the studies

Relevant articles were identified by means of a computerized search in the bibliographic databases PubMed and Web of Science from 1988 up to December 2007. The following combination of Mesh-terms and keywords was used: (Workplace OR employee* OR worker*) AND (exercise OR fitness OR (physical activity) OR sport OR nutrition OR fat OR fruit* OR vegetable*) AND (intervention OR program*) AND (participa* OR response OR respondent*). For the literature search in Web of Science the Mesh terms were converted to keywords. For inclusion articles had to fulfil the following criteria: (1) the article described a WHPP on physical activity and/or nutrition as primary preventive intervention (primary prevention has been defined as the promotion of health by personal and community-wide efforts)[11] (2) a quantitative description of determinants of initial participation at the start of the programme was given, (3) the association between demographic, health-related, or work-related determinants and participation was expressed in a quantitative measure, such as an odds ratio, or sufficiently raw data were provided to calculate these associations, and (4) the article was written in English.

Selection

The first author (SR) performed the initial selection of abstracts in the literature search. In case of doubt, the last author (AB) was consulted. Figure 4.1 shows the flow of the articles throughout the inclusion process. Based on title and abstract, 593 out of 876 articles were discarded because 500 abstracts (57%) did not describe a WHPP, 33 abstracts (4%) were on a WHPP other than nutrition or physical activity, and another 36 abstracts (4%) were no original studies. Finally, 24 abstracts (3%) were excluded for a variety of reasons, such as describing characteristics of worksites that offer a WHPP instead of employees that do or do not participate (n=7), no primary prevention (n=4), and willingness to participate instead of actual participation (n=2).

In total, 283 articles were retrieved for full review, of which 31 out of 261 (12%) were excluded due to not describing a WHPP, nine (3%) because they did not describe a programme on nutrition or physical activity, and 41 articles (16%) were excluded for a variety of reasons. Of the remaining 180 articles describing a WHPP on nutrition or PA, 172 (96%) did not include any information on characteristics of non-participation and eight studies (4%) did not include any quantitative information on these characteristics. Finally, 22 (9%) publications met our inclusion criteria.

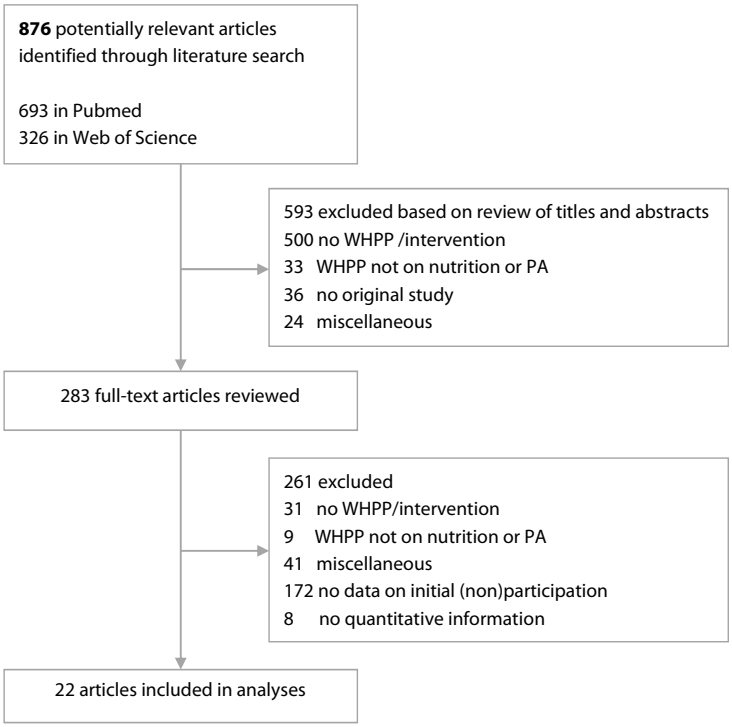

Figure 4.1 Flow chart

Data extraction

A data form was used to extract information on the number of participants, the target population, demographic (e.g. sex, marital status) as well as health- (e.g. physical activity, weight) and work-related (e.g. job type, company size) determinants of participation. Finally, programme characteristics as the availability of incentives, the requirement of paying a fee to participate, the programme type and the targeted behaviour were obtained. The first author (SR) performed the data extraction and the last author (AB) verified all extracted data. In case of doubt, data were discussed until agreement was reached.

After the data extraction, programmes were divided in three groups: (1) programmes with a fitness centre or exercise programme as main component, (2) with education or counselling as main component, (3) and multi-component programmes. One study evaluated a fitness centre programme next to a multi-component programme, and described the determinants of participation in both programmes separately.[12] The determinants of this study were considered separately for both programmes, resulting in 22 publications describing 23 studies.

Data analysis

The first step in the data analysis was to express participation levels as a proportion of the number of eligible participants. Subsequently, the analysis focused on measures of associa-

tion between determinants of participation and participation levels. In case no measures of association were included in the original article, available raw data in a 2 × 2 table were used to calculate an odds ratio and 95% confidence intervals for dichotomous or categorical measures, with odds ratios above and below 1 representing respectively higher and lower participation. A pooled odds ratio was calculated using a random effects model due to observed heterogeneity between studies. For continuous measures, the difference between means (Δ) among participants and non-participants was calculated and a Cohen's d value was calculated reflecting the standardized difference between means. A d-value of 0.2 was considered to represent a small difference, 0.5 a medium difference, and 0.8 a large difference. The influence of programme characteristics on participation level was analysed by a meta-analytical approach, pooling the participation numbers and total population numbers for the relevant programme characteristics.

RESULTS

Determinants of participation were reported in ten studies with education or counselling as main component,[13-22] six studies on the introduction of a fitness centre or exercise facilities,[12,23-27] and seven studies describing a multi-component programme[12,28-33] (Tables 4.1, 4.2, 4.3). All 23 studies reported demographic factors,[12-33] 11 (48%) health-related aspects,[12-13,17,21,23-26,31,33] and seven (30%) work-related determinants.[14,17,18,22,29-31] The participation levels ranged from 10% to 64%,[12] with a median of 33% (95% CI 25%–42%).

The demographic determinants most often reported were sex (n=22), age (n=19), ethnicity (n=10), education (n=8), marital status (n=7), and income (n=3) (Tables 4.1, 4.2, 4.3). Most studies reported a higher participation among women (n=16), of which 12 reached statistical significance.[12,14,16,18-20,29-33] In contrast, six studies found a higher participation among men,[15,21,22,24-26] of which three were statistically significant.[15,24,26] A higher participation among female employees was found for educational and multi-component programmes, but not for fitness centre facilities (Table 4.2).

Contradictory results were reported for age with both statistically significant higher[13,18,28,31,33] and lower[12,20,24,27,32] participation levels among older employees. For marital status, five[16-18,29,33] out of seven studies found a higher participation level among married or cohabiting employees (of which two were statistically significant).[16,33] Two out of six studies that reported a higher participation level among Caucasian or white employees found a statistically significant difference in comparison with black or Hispanic employees.[15,28] None of the four studies reporting a lower participation among Caucasian or white employees reached statistical significance.[12,26,29] Concerning education and income, both positive and negative associations were reported. Four positive statistically significant associations were found for a higher education level,[26,28,32,33] and one study reported a higher participation level for those with a

lower education level.[12] One out of three studies showed a higher participation level among workers with a higher income.[26]

A large variety of health-related determinants were addressed, most notably (over)weight (n=6), physical activity level (n=5), smoking (n=3), cholesterol level (n=3), general health/ health risks (n=3), blood pressure (n=2), and nutrition (n=1). For health-related determinants, there is no consistent evidence for a higher participation among healthier workers. Lewis (1996) reported contrary findings for the multi-component and fitness centre programme: a higher participation among employees with obesity and hypertension risk in the multi-component programme and a higher participation among those with a low fitness and obesity risk in the fitness centre intervention.[12] One study reported a higher participation among those with an elevated cholesterol level in a nutrition programme.[13] Some studies reported a higher participation level among those with less health risks,[21,25] and those with less sick leave.[24]

Work-related determinants studied were job type (n=5), employment (full-/ part-time) (n=3), company size (n=1), and work shift (n=1). The only statistically significant associations were a higher participation among white-collar or workers with secure contracts,[30, 31] fulltime-workers,[22,31] and employees in smaller companies.[14] A lower participation level was found for those with shift work.[29]

In Table 4.4 the pooled ORs for the demographic determinants are provided. In accordance with the individual studies described above, a statistically significantly higher participation level among female workers was found (OR 1.67, 95% CI 1.25–2.27). After stratifying by programme type, no difference between male and female workers was observed in the fitness centre studies (OR 1.02, 95% CI 0.68–1.53) as compared to education/counselling and multi-component studies (OR 2.00, 95% CI 1.43–2.78). A significant higher participation level was found for married/cohabiting workers compared to other (OR 1.25, 95% CI 1.05–1.48). Age, education, and income had no effect on participation.

Table 4.5 shows higher participation levels in programmes offering incentives, and in multi-component interventions. No difference in participation levels was found between programmes requiring a fee and programmes with free participation. The difference in mean participation level between studies aimed at physical activity and studies aimed at multiple behaviours reached statistical significance.

Table 4.1 Participation levels and determinants of participation in educational or counselling worksite health promotion programmes

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Franklin 2006[16]	cohort	Employees of an insurance company (n=960)	Daily e-mail messages with self-monitoring on nutrition and physical activity (6 months	40% (n=388) (n=345 completed baseline health survey)	male gender age (30-49) age (50+) white ethnicity married income, $30.000-$59.999 income, > $59.999	0.34 [0.24-0.49]* 1.30 [0.72-2.33] 1.47 [0.79-2.74] 1.22 [0.78-1.93] 1.43 [1.08-1.91]* 1.50 [1.08-2.09]* 0.90 [0.58-1.41]
Thomas 2006[20]	cohort	Government employees (n=3500)	information session with goal setting, pedometer use and e-mail support for physical activity (4 wk)	34% (n=1195) (n=927 provided demographics)	male gender age (30-49) age (50+)	0.46 [0.39-0.54]* 0.73 [0.60-0.89]* 0.82 [0.66-1.02]
McCarty 2005[19]	cohort	Employees of a health care system (n=6539)	Self-monitoring and e-mail support to increase physical activity and nutrition (16 wk)	17% (n=1129)	male gender	0.10 [0.08-0.14]*
Marshall 2003[17]	RCT	University employees (n=1409, results on n=800 responded to questionnaire)	8 week programme with printed (I1) or website (I2) education and 4 reinforcement moments respectively by letter and e-mail.	46% (n=655)	male gender age (yrs, mean) intermediate/high education married BMI (kg/m^2, mean) good/excellent health full-time employment academic job classification	0.77 [0.53-1.10] Δ 0 yrs; d 0.00 0.70 [0.46-1.07] 1.15 [0.78-1.70] Δ 1 kg/m^2; d 0.14 0.69 [0.37-1.27] 0.69 [0.41-1.16] 0.79 [0.55-1.14]
Cornfeld 2002[15]	cohort	Employees and spouses of 6 companies (n=21396)	1-time health risk assessment with personalized feedback letters on cancer risk factors	21% (n=4395)	male gender age (yrs, mean) Caucasian ethnicity	1.16 [1.09-1.24]* P: 44.8; all: 43.0 4.05 [3.52-4.67]*
Gold 2000[21]	Non-randomized controlled trial	Employees of 6 companies from the private and public sector (n=1741)	Education materials, 6-monthly telephone counselling sessions on 7 risk areas (12- 24 months)	35% (n=607)	male gender age (yrs, mean) #health risks (lifestyle areas 0-13)	1.13 [0.93-1.38] Δ -1 yr Δ -0.34 risks*
Blake 1996[14]	cohort community intervention	Employees in companies in the Minnesota Heart Health Program (n=17626)	3 exercise competitions between companies with recording the type and minutes of daily exercise.	37% (n=6495)	male gender company size, 45-500 workers company size, >500 workers	0.28 [0.26-0.31]* 0.22 [0.19-0.25]* 0.09 [0.08-0.10]*

Table 4.1 Participation levels and determinants of participation in educational or counselling worksite health promotion programmes (contrinued)

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Hooper 1995[22]	cross-sectional	University employees and spouses (n=338)	Self-monitoring to increase physical activity (20 wk).	30% (n=103)	male gender higher education white ethnicity married full-time employment faculty employees	1.20 [0.70-2.07] 1.06 [0.66-1.71] 1.18 [0.45-3.11] 0.91 [0.50-1.66] 1.86 [1.01-3.43]* 0.68 [0.40-1.13]
Baer 1993[13]	Non-randomized controlled trial	Management-level male employees with elevated total cholesterol levels (n=70)	An individual instruction, every 3 months group meetings, and monthly telephone support to decrease cholesterol level.	47% (n=33)	age (yrs, mean) aerobic activity (days/wk, mean) cholesterol level >6.17 weight (kg, mean) % body fat (mean) non smoker	Δ 9 yrs*; d 2.55 Δ 0 days/wk; d 0.00 14.3 [4.2-50.0]* Δ 1 kg; d 0.39 Δ 1%; d 0.24 3.00 [0.56-16.03]
Mavis 1992[18]	cross-sectional	Stratified sample of university employees (n=110 invited, 81% response)	Health fair and health habit modification programmes on exercise, weight control, stress management and smoking cessation.	25% of respondents (n=22)	male gender age (yrs, mean) married/cohabiting income above $30.000 faculty employees (vs clerical)	0.30 [0.11-0.83]* Δ 5.6* 1.89 [0.70-5.11] 0.62 [0.19-2.03] 0.11 [0.02-0.60]*

Table 4.2 Participation levels and determinants of participation in worksite health promotion programmes offering access to a fitness programme

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Lechner 1997[23]	cohort	Sample of participants and non-participants from police, chemical industry and banking company (n=900)	Fitness programme with supervised fitness exercises 2x/wk for 1 hour	53% of stratified sample (n=415)	male gender age (yrs, mean) # sick days (days, mean)	0.77 [0.53-1 .12] Δ -1.1 yrs; d -0.14 Δ -1.93 days
Lewis 1996[12]	cohort	Employees of a petrochemical R&D company	Fitness centre	fitness centre: 10% (n=151)	male gender age, 31-50 age, 50+ higher education white ethnicity low fitness risk low obesity risk	0.53 [0.38-0.75]* 0.53 [0.35-0.79]* 0.43 [0.25-0.75]* 0.88 [0.56-1.37] 0.82 [0.54-1.23] 2.53 [1.52-4.21]* 1.67 [1.05-2.66]*
Heaney 1995[26]	cohort	Newly hired insurance company employees (n=294)	Membership of a company's fitness centre within first year of employment.	19% (n=55)	male gender age, 31-40 age, >40 education some college education college graduate white ethnicity married pay grade 7-13 pay grade above 14 normal SBP normal DBP <20% overweight 11-20% overweight 1-2x/wk physical activity >2x/wk physical activity non smoker	2.04* 1.71 0.90 0.85 2.29* 0.66 0.90 4.29* 7.08* 0.86 1.75 1.06 1.05 0.85 1.04 1.37

Table 4.2 Participation levels and determinants of participation in worksite health promotion programmes offering access to a fitness programme (continued)

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Steinhart 1992[27]	cohort	Employees in oil company (n=2000): respondents: 76% of participants (n=400) and 88% of sample of non-participants (n=246)	Membership of a company's fitness centre within the first 6 months of existence	26% (n=526)	within questionnaire respondents: male gender age, 30-49 age, 50+	 0.89 [0.64-1.05] 0.66 [0.45-0.97]* 0.32 [0.18-0.56]*
Lynch 1990[24]	cohort	Employees of an insurance company (n=8069)	Membership of a company's fitness centre, within the first 2 yrs of existence.	28% (n=2232)	male gender age men (yrs, mean) age women (yrs, mean) sick leave men (days, mean) sick leave women (days, mean)	1.62 [1.47-1.79]* Δ -1.0 yrs* Δ -5.3 yrs* Δ -0.63 days* Δ -0.93 days*
Shephard 1980[25]	cross-sectional	Employees of a food corporation (n=2400) (76% of the participants (n=409 and 44% of a random sample of non-participants (n=374) completed the questionnaire)	Physical assessment and membership of the company's health fitness centre.	22% (n=535)	male gender age, 30-49 age, 50+ activity past 3 months (mean), m activity past 3 months (mean),f health rating (mean) m health rating (mean) f	1.07 [0.89-1.30] 1.72 [1.37-2.17]* 1.14 [0.85-1.52] Δ 0.16 Δ 0.23 Δ 0.12 Δ 0.3*

Table 4.3 Participation levels and determinants of participation in multi-component worksite health promotion programmes

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Stein 2000[31]	cohort (adjusted data)	Benefit-eligible hospital employees (n=2421)	Health risk assessment with results converted to dollar equivalents, plus a series of health promotion activities on physical activity, weight, nutrition, smoking, and stress management for variable time periods.	29%	male gender age 25-34 age 35-44 age 45-54 age 55+ white ethnicity not at risk (body fat) not at risk (cholesterol) full-time employment salary worker	0.38 [0.30-0.50]* 1.30 [1.03-1.62]* 1.43 [0.91-2.22] 1.79 [1.46-2.16]* 1.16 [1.13-1.17]* 1.28 [0.86-1.92] PR 0.42 PR 0.69 1.79 [1.41-2.22]* 1.54 [1.27-1.89]*
Lerman 1996[33]	cohort	Career army personnel and spouses (n=not available)	A 4-day vacation programme with lectures, workshops, and access to sport facilities.	not available (n=353)	male gender age 30-39 age, 40+ married intermediate education higher education non smoker	0.67* 1.66* 2.21* 4.14* 0.77 1.70* 4.81*
Lewis 1996[45]	cohort	Employees of a petrochemical R&D company (n=2290)	Health risk assessment, fitness centre, and education classes on physical activity, weight, nutrition, smoking, stress-management and blood pressure during a period of 2 yrs.	wellness programme: 64% (n=1471)	male gender age, 31-50 age, 50+ higher education white ethnicity low fitness risk low nutrition risk low cholesterol risk low obesity risk low hypertension risk	0.34 [0.28-0.43]* 0.66 [0.51-0.85]* 0.57 [0.42-0.77]* 0.75 [0.59-0.96]* 0.97 [0.78-1.21] 1.45 [1.09-1.94]* 0.91 [0.56-1.50] 0.85 [0.66-1.09] 0.25 [0.15-0.43]* 0.41 [0.18-0.94]*
Sorensen 1996[30]	cRCT (adjusted data)	Random sample of employees of intervention worksites in the WellWorksTrial (n=2767)	Cancer-prevention intervention with several activities on individual and organizational level on nutrition, smoking, occupational safety for a 2-yr period.	nutrition programme: 49% (n=1224)	male gender white collar worker vs. crafts/labourers	0.45 [0.36-0.56]* 1.52 [1.23-1.89]*

Table 4.3 Participation levels and determinants of participation in multi-component worksite health promotion programmes (continued)

Study	Study design	Study population	Programme content	Participation	Determinants of participation	OR [95% CI]
Knight 1994[32]	cohort	University employees with 2 yrs of continuous employment (n=4972)	Health screens and lifestyle improvement programmes on smoking cessation, weight control, stress management, nutrition, fitness and blood pressure.	63% (n=3122)	male gender age, 35-54 age, >55 higher education white ethnicity	0.48 [0.42-0.54]* 0.96 [0.85-1.08] 0.64 [0.52-0.79]* 1.22 [1.09-1.37]* 1.12 [0.99-1.25]
Henritze 1992[29]	cohort	Food Company employees (n=1320)	Health screening followed by a variety of programmes during a 8-wk period: exercise equipment, and classes on activity, nutrition, hypertension and smoking.	52% (n=692)	male gender age (yrs, mean) Caucasian ethnicity married shift work	0.57 [0.43-0.76]* P: 42.6, all: 43.0 0.83 [0.60-1.15] 1.13 [0.87-1.48] 0.57 [0.45-0.73]*
Brill 1991[28]	cohort	Teachers in schools (n=11830)	Health screen followed by 10-wk programme with exercise sessions and health education classes.	33% (n=3873)	male gender age, 36-50 age 50+ higher education white ethnicity	0.95 [0.86-1.04] 1.50 [1.37-1.64]* 1.34 [1.21-1.49]* 1.76 [1.56-2.00]* 2.04 [1.88-2.21]*

Table 4.4 Pooled odds ratios and corresponding 95% confidence intervals for participation levels for specific demographic determinants

determinant		studies (n)[a]	OR	95% CI
sex	female:male	20	1.67*	1.25 - 2.27
age	middle:young	8	0.93	0.71 - 1.24
	old:young	8	0.76	0.54 - 1.06
education	moderate/high:low	6	1.04	0.77 - 1.40
income	high:low	2	0.86	0.56 - 1.31
ethnicity	white:other	9	1.33	0.91 - 1.95
marital status	married:other	5	1.25*	1.05 - 1.48

* $p < 0.05$, [a] The total number of studies included in this table varies per characteristic. For each demographic characteristic, only studies enabling to calculate OR's and CI's are included

Table 4.5 Pooled participation levels and corresponding 95% confidence intervals for study characteristics

study characteristics	studies (n)[a]	participants (n)	mean (%)	95% CI
incentive	9	11960	33.5%	33.3% - 33.8%
no incentive	13	18060	30.7%	30.5% - 30.9%
fee	4	4053	32.2%	31.8% - 32.7%
no fee	18	26740	31.7%	31.5% - 31.9%
education/counselling	10	15022	28.0%	27.8% - 28.2%
fitness	6	3914	25.8%	25.4% - 26.1%
multi-component	6	11084	43.3%	42.9% - 43.3%
physical activity	10	6474	29.2%	28.9% - 29.5%
multiple behaviours	12	23546	32.6%	32.4% - 32.8%

[a]The total number of studies included in this table varies per characteristic. For each demographic characteristic, only studies enabling to calculate OR's and CI's are included.

DISCUSSION

In this systematic review, participation levels in health promotion interventions at the workplace were typically below 50%. A large variation in participation levels and determinants of initial participation in worksite health promotion was shown, and except for sex few statistically significant associations with initial participation were found. Female workers had a higher participation than men, but this difference was not observed for interventions consisting of fitness centre programmes. In addition, the review showed that programmes that provide (1) incentives, (2) offer a multi-component strategy, (3) focus on multiple behaviours rather than on physical activity only have a higher overall participation level.

A major reason for choosing the worksite as setting for health promotion is the possibility to reach large groups.[7,9] It is striking that the differences between participation levels were large, with mainly low participation levels, but also levels up to 64%. The large variation is comparable to the findings of Glasgow and colleagues (1993), who found participation levels ranging from 20% to 76%. The authors noticed that attending a single screening does not require much commitment.[9] In our review, we included only studies evaluating interventions aimed at physical activity and/or nutrition, and therefore excluded studies evaluating only

a single health risk assessment (HRA). The median participation level found in a review on 24 studies by Bull and colleagues (2003) was higher than the median reported in this review (61% versus 34%).[7] It is not clear if Bull and colleagues included studies evaluating a HRA.

The findings on determinants of participation are in accordance with the review of Glasgow and colleagues.[9] The overall view is that female employees are more likely to participate in health promotion programmes than male employees.

After pooling, an overall higher participation level for married employees was found. All other demographic characteristics showed no consistent pattern. Only for age, there appeared to be a trend with a higher participation among younger employees, and lowest participation level among the oldest age group. As mentioned, just few statistically significant associations for health- and work-related determinants were found. Several studies have reported higher participation in smaller worksites albeit without providing quantitative information.[34-35] This finding is supported in this review by the included study of Blake and colleagues (1996).[14] No pooled ORs were calculated for the health- and work-related determinants due to the large variation in definition of determinants and programmes evaluated.

More than 80% of the studies evaluating a WHPP on nutrition or PA did not report any determinants of non-participants. In 1993, Glasgow and colleagues already recommended that future studies should report participation levels, the number of employees entering the programme, and demographic information.[9] This information is needed to gain insight in potentially selective participation and external validity. Just few studies included information on educational level and income. Since unhealthy lifestyles are more common among lower socio-economic groups, it is important to get insight in the reach (and effectiveness) in these specific groups. Information on determinants should be an essential aspect of a process evaluation. In the RE-AIM framework for the evaluation of the public health impact of health promotion interventions, the 'reach' dimension is included which is measured by comparing records of participants and complete sample information for a defined population, in this case the worksite.[36] In the recent CONSORT statements it is emphasized to include information on the eligible participants in order to increase the validity.[37]

In total, 64 out of 130 (49%) associations between determinants and participation did not reach statistical significance. These null associations may be the result of a small sample size and lack of statistical power, and the presence of another risk factor or confounder.[38] It is not likely that most null associations are explained by the sample size or confounding, because most studies had sample sizes larger than 500 subjects, and most ORs were calculated by means of univariate analysis. Thus, the lack of a clear health-related selection in participation suggests that WHPPs are able to reach those most-at-risk and, hence, provide a valuable setting.

After stratification of the demographic determinants by programme type, it appeared that fitness centre studies do not suffer from a lower participation among men. Further, no statistically significant differences in demographic determinants were found between

programme categories. The finding that fitness centre studies do not favour female workers in comparison with other programme categories, suggests that the content of intervention programmes should be tailored to the population characteristics.

In addition to determinants that may play a role in the uptake of interventions in the context of work settings, several programme characteristics were associated with participation. First, this review and others[39] suggest that the inclusion of an incentive can have beneficial effects on reach, hence increasing the absolute number of people who engage in health-related activities. Second, the present finding that more multi-component interventions do not decrease the uptake is in itself reassuring. A potential explanation for this finding may be that these interventions offer a large choice for potential participants. It could be hypothesized that multi-component interventions may have bigger participation levels as it matches with a larger array of people, whereas a mismatch is more likely for single components whereby persons may not see the need or be ready to engage in a particular activity. Finally, in this review a fee for participation was not identified as a barrier to participate. The four studies reporting on interventions with a fee for participation included one very large study.[28] Excluding this study showed among the remaining three studies a lower participation level (participation level 24.3%; 95% CI 22.7%–25.8%) as compared to studies not requiring a fee for participation (participation level 31.7%; 95% CI 31.5–31.9%). This indicates that the results of the pooled analysis should be interpreted carefully depending on the studies included.

Low participation levels will result in decreased (cost-)effectiveness of intervention programmes on population level and a potentially decreased generalizability of the results.[40] Implications for raising participation levels in WHPPs are the provision of incentives, or a broad array of programme offers. To what degree these strategies affect also compliance to an intervention programme should be considered.

Limitations

This systematic review has some limitations. First, the literature search was limited to two electronic databases, with an overlap of 86% of the articles. With just two electronic databases and only English publications included, it is possible that we missed some useful studies. We assume this does not have a major effect on the findings. Second, many interventions are conducted in practice that are not well evaluated and not published in scientific literature. This review is limited to the published research. Third, eight out of 30 studies were excluded because they reported only qualitative information on initial participation. Fourth, pooling of all determinants was impossible because of the large heterogeneity in definition of initial participation, in programme components, and measurement of determinants. Finally, due to the limited information provided in studies, the possibility to study the interaction between determinants and programme characteristics was restricted.

Conclusion

In this systematic review, participation levels in health promotion interventions at the workplace were typically below 50%. This will greatly influence the effects of these interventions. Few studies evaluated the influence of health, lifestyle and work-related factors on participation, which hampers the insight in the underlying determinants of initial participation in worksite health promotion. This insight is essential to develop tailored intervention programmes, to reach those who need it most, and to increase generalizability across all workers.

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5

The cost-effectiveness of an individually tailored long-term worksite health promotion programme on physical activity and nutrition: design of a pragmatic cluster randomized controlled trial

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ABSTRACT

Background Cardiovascular disease is the leading cause of disability and mortality in most Western countries. The prevalence of several risk factors, most notably low physical activity and poor nutrition, is very high. Therefore, lifestyle behaviour changes are of great importance. The worksite offers an efficient structure to reach large groups and to make use of a natural social network. This study investigates a worksite health promotion programme with individually tailored advice in physical activity and nutrition and individual counselling to increase compliance with lifestyle recommendations and sustainability of a healthy lifestyle.
Methods/Design The study is a pragmatic cluster randomized controlled trial with the worksite as the unit of randomization. All workers will receive a standard worksite health promotion programme. Additionally, the intervention group will receive access to an individual Health Portal consisting of four critical features: a computer-tailored advice, a monitoring function, a personal coach, and opportunities to contact professionals at request. Participants are employees working for companies in the Netherlands, being literate enough to read and understand simple Internet-based messages in the Dutch language. A questionnaire to assess primary outcomes (compliance with national recommendations on physical activity and on fruit and vegetable intake) will take place at baseline and after 12 and 24 months. This questionnaire also assesses secondary outcomes including fat intake, self-efficacy and self-perceived barriers on physical activity and fruit and vegetable intake. Other secondary outcomes, including a cardiovascular risk profile and physical fitness, will be measured at baseline and after 24 months. Apart from the effect evaluation, a process evaluation will be carried out to gain insight into participation and adherence to the worksite health promotion programme. A cost-effectiveness analysis and sensitivity analysis will be carried out as well.
Discussion The unique combination of features makes the individually tailored worksite health promotion programme a promising tool for health promotion. It is hypothesized that the Health Portal's features will counteract loss to follow-up, and will increase compliance with the lifestyle recommendations and sustainability of a healthy lifestyle.

INTRODUCTION

Cardiovascular disease

Cardiovascular disease (CVD) is the leading cause of disability and mortality in most Western countries. CVD causes nearly half of all deaths in Europe (49%).[1] Major modifiable risk factors for CVD include smoking, alcohol use, low physical activity (PA), and poor nutrition. The prevalence of several risk factors is very high, most notably low PA and poor nutrition (low fruit and vegetable consumption and high saturated fat intake).

According to a survey in European Union countries in 2002, 56% of the Dutch population over 15 years was insufficiently physically active for health.[2] The Dutch recommendation on PA stipulates that an adult should engage in PA of at least moderate intensity for at least 30 minutes a day on five days a week, and preferably every day in order to obtain health benefits.[3] In 2006, about half of the Dutch adults (25–55 year) met this recommendation.[4] In order to improve physical fitness it is recommended to engage in PA of vigorous intensity for at least 20 minutes on at least three days a week.[3] Exercise capacity has been found to be a powerful predictor of mortality.[5] It has been estimated that the life expectancy for people with low PA levels at age over 50 is 1.4 years less than for people with moderate PA levels and even 3.8 years less than for people with high PA levels.[6]

The results of a recent meta-analysis on cohort studies indicate that fruit and vegetable consumption is inversely associated with the occurrence of coronary heart disease. The risk of coronary heart disease decreased by 4% for each additional portion of fruit and vegetables per day.[7] In the last representative Dutch food intake survey in 1997/1998 less than a fourth of the Dutch population met the recommendation for vegetable (200 grams a day) and fruit intake (200 grams a day).[8] Regarding saturated fat intake, only 9% of the Dutch adult population met the recommendation (a maximum of 10 per cent of energy intake as saturated fat) in 1997/1998.[9] A high intake of saturated fat increases the risk of coronary heart disease.[10]

The imbalance between PA and nutrition is an important cause of overweight and obesity, which in turn are important risk factors for CVD.[11] In the Netherlands self-reported overweight (body mass index (BMI)≥25 kg/m^2) in adult men increased from 37% in 1981 to 51% in 2004, and in adult women from 30% in 1981 to 42% in 2004.[12]

Worksite health promotion

In the prevention of cardiovascular disease, lifestyle behaviour changes are of great importance. Worksites have specific features that make them a promising place for health promotion. Worksites offer an efficient structure to reach large groups, enable the introduction of social support, and make use of a natural social network for peer support.[13-14]

Literature shows contradictory results of randomized controlled trials (RCTs) on worksite health promotion programmes (WHPPs). A recent systematic review concluded that there is strong evidence for effectiveness of WHPP, based on two RCTs with a small effect on exercise

behaviour and on energy expenditure.[15] However, another review on worksite PA programmes reported a small average effect size of 0.04 (95% CI -0.04–0.12) based on RCTs on self-reported level of PA 1-144 months after the intervention ceased.[13] A third review on environmental and policy interventions presented preliminary evidence that combined health education, screening, counselling, peer support, and access to (on-site) exercise equipment had positive effects on fitness levels, frequency of exercise, cholesterol levels, and systolic blood pressure. Several randomized studies on point-of-purchase nutrition interventions, some in worksites, showed positive effects on fruit and vegetable consumption, self-reported fat intake, cholesterol, and body weight but other studies have failed to corroborate these findings.[16]

The overall picture emerges that WHPP may increase PA and improve nutritional intake among targeted groups, depending on the critical features of the interventions. Amongst others, as success factors of WHPP have been identified: (1) interventions tailored to the individuals' readiness for exercise adoption, (2) programmes that integrate specific components (nutrition, smoking, PA) into a combined approach, and (3) linking individual approaches to environment and policy conditions.[17] Marcus and colleagues showed that workers receiving self-help exercise promotion material tailored to the individual's readiness were significantly more likely to have increased exercise.[18] An individualized approach of high-risk employees within the framework of a comprehensive programme proved to be a critical feature of worksite interventions.[19] Recent studies have shown that web-based education tailored to personal characteristics may increase fruit and vegetable consumption and PA level, and decrease fat intake. In these interventions people received personalized feedback and advice that directly matched their individual behaviour, motivation, perceived (dis)advantages, and self-efficacy beliefs.[20] Based on results of their study on e-mail messages to promote health behaviours, Franklin and colleagues. suggest that e-mails may contribute to the effective deliverance of health promotion programmes.[21]

In contrast, three factors have been identified as greatest risks for ineffective WHPP: (1) a low, selective participation, (2) lack of adherence to the WHPP, and (3) an intervention effort too short for sustainable change in behaviour.[13,15-16] In several worksite studies intervention and evaluation periods were too short to determine the sustainable impact of environmental conditions.[16]

In conclusion, previous WHPPs have shown contradictory results. Studies are needed on a WHPP that counteracts the three main factors for ineffectiveness.

In the study protocol described in this article, a long-term WHPP will be evaluated that adds the following four critical features to a traditional WHPP: (1) a computer-tailored advice on PA and diet (to increase awareness and adherence to the WHPP) (2) insight in progress over time on health-related behaviours (to increase adherence to the WHPP, compliance with the lifestyle recommendations and sustainability of a healthy lifestyle), (3) continuous feedback and support through monthly e-mails (personal coach) for 12 months (to increase adherence to the WHPP and compliance with and sustainability to the lifestyle recommendations), and (4) opportunities to seek personal advice from a variety of professionals (to increase adherence to the WHPP).

Objectives

The aim of this pragmatic cluster randomized controlled trial is to evaluate the cost-effectiveness of a new investigator-driven WHPP with individually tailored advice in PA and nutrition and individual counselling to increase compliance with the lifestyle recommendations and sustainability of a healthy lifestyle.

METHODS

Study design and population

The study is a single blind pragmatic cluster randomized controlled trial with the worksite as the unit of randomization. The intervention is targeted at the individual level. The study population consists of workers in companies that offer a standard WHPP to their employees, as provided by an organization specialized in health management (Lifeguard Inc., Utrecht). Eligibility criteria for individual workers in the study are: 1) paid employment, 2) working at least 12 hours a week, and 3) being literate enough to read and understand simple e-mail and Internet-based messages in the Dutch language. All participants are blinded to the type of intervention. Data collection starts in September 2007 and will continue until August 2010. Participants will be requested to fill out a questionnaire at baseline and after 12 and 24 months. A physical examination (the 'health check') will take place at baseline and after 24 months. The study design and participant flow are shown in Figure 5.1. The Medical Ethics Committee of Erasmus MC, University Medical Center Rotterdam, the Netherlands, approved the study protocol.

Randomization

Within each company, units will be randomized by a researcher not involved in the study, based on a table of random numbers (SAS command Ranuni). Within each company, worksites with comparable work activities and a comparable number of workers will be randomly allocated to the intervention or the control group. Subsequently, workers within each unit will be asked to participate in the study, presented as an evaluation study of different types of WHPP. All participants from one worksite will be randomized together rather than individually because individual randomization may lead to contamination of the control group. Written informed consent at individual level is collected after agreement of the employer and randomization at cluster level. Since it is deemed not possible within companies to withheld participation in a WHPP, workers within the control group will receive a standard WHPP.

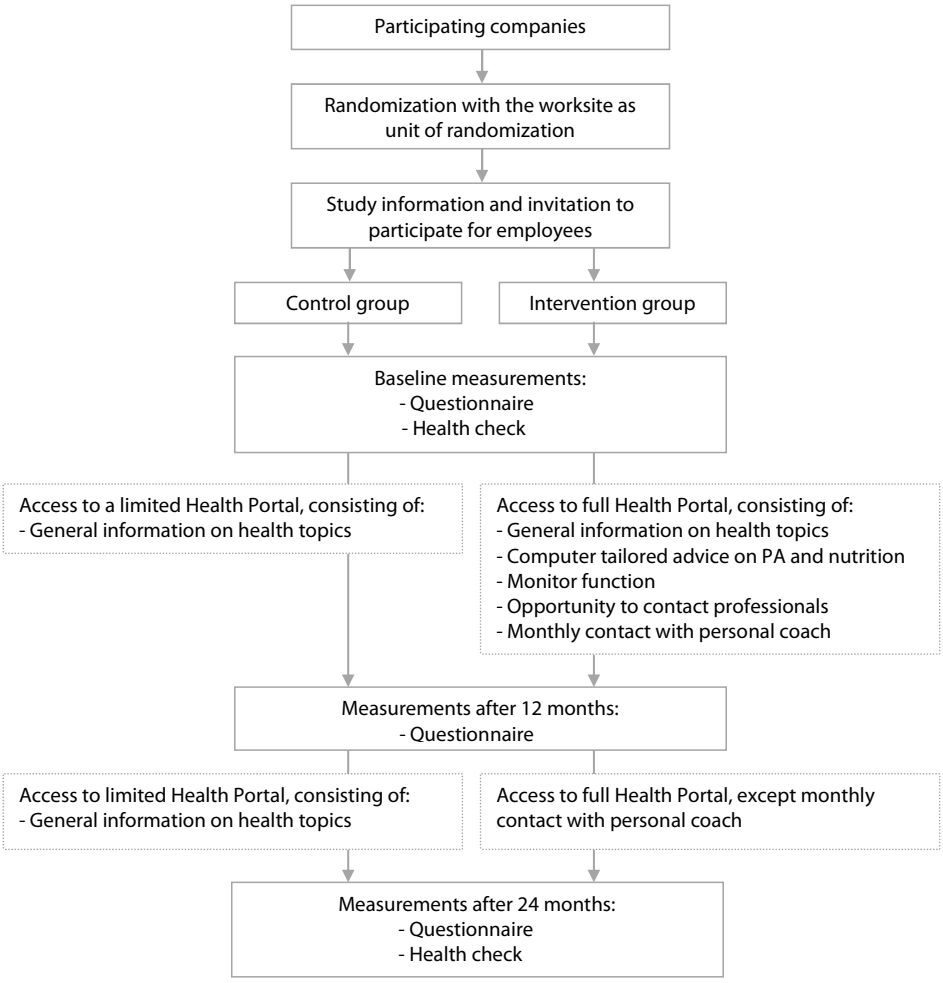


Figure 5.1 Flow of participants through the trial

Standard programme

The standard WHPP consists of:

1) A questionnaire to assess, among other things, PA level and fruit and vegetable intake.
2) A health check to assess weight, length, total blood cholesterol level, blood pressure, resting heart rate, body mass index, percentage of body fat, and predicted maximal oxygen uptake.
3) Advice of the provider's personnel, based on the outcomes of the questionnaire and health check. In addition, workers with a high total cholesterol level or high blood pressure will be referred to their general practitioner.

4) Access to a restricted part of the Health Portal on Internet, containing general information on health and health-related behaviours. The individual results on the questionnaire and health check are also retrievable through this website.

Intervention

On top of the standard WHPP the intervention group will have full access to the personalized Health Portal on Internet. The Portal contains four critical features: a computer-tailored advice, a monitoring function, a personal coach, and opportunities to contact professionals at request.

Computer-tailored advice

Participants will receive a computer-tailored advice to increase awareness of their lifestyle.[22] Awareness is found to be an important mediator of participation in health promotion programmes.[23] The benefits of computer tailoring is attributed to the fact that individualized feedback commands greater attention, is processed more intensively, contains less redundant information, and is appreciated better than the provision of general documentation.[24]

After baseline measurements the participant in the intervention group will receive an e-mail with the notification that a personal advice is available on the Health Portal. Considering the answers on the questionnaire filled out at baseline a personal advice on PA, fruit and vegetable consumption, and fat intake will be generated. The advice aims to increase adherence to the intervention and to motivate the participant to engage in PA and a healthy diet, and consists of the following parts:

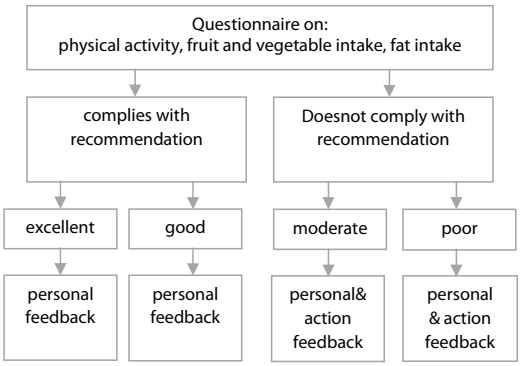
1) Personal feedback: feedback on to what extent the recommendations on PA and dietary intake are met.
2) Action feedback: feedback on the specific barrier attributed by the participant as most important to not meeting the recommendations. The advice also contains opportunities to link to further information on the Health Portal and provides tips on how to meet the guidelines.

If one meets the recommendations, only the personal feedback is provided. See Figure 5.2 for an example of the computer tailored advice.

Monitoring function

Second, a monitoring function is integrated in the Health Portal to increase adherence to the intervention programme and consequently increase compliance with the lifestyle recommendations and sustainability of healthy behaviour. Recent studies have shown that people who want to change their lifestyle should be encouraged to regularly monitor their progress in adopting a new behaviour.[25-26]

With the monitor function individual progress charts on self-reported weight, BMI, PA, and fruit and vegetable intake will be generated. The results of the baseline measurements will be



Fruit and vegetables

Item	Score	Low				High
		0	100	200	300	400 gram
Vegetables	81					
		0	100	200	300	400 gram
Fruit	225					

Vegetables
Do you eat enough vegetables?
According to our calculations you eat on average 81 grams of vegetables per day. With this, you eat an insufficient amount of vegetables. To meet the recommendation you should eat 119 grams of vegetables more every day.

Fruit
Do you eat enough fruit?
According to our calculations you eat on average 225 grams of fruit per day. This means that you eat a sufficient amount of fruit. Congratulations, that is a very healthy habit!
You let us know that you do not have enough time to eat more fruit and/or vegetables. Did you know that frozen and canned vegetables contain as much vitamins and minerals as fresh vegetables? Do not wait with eating vegetables until dinner. You can eat vegetables at lunch or as a snack. Think about slices of tomato or cucumber on bread or a salad. Start the day with a glass of orange juice or vegetable juice. Here you can find a table with information of fruit and vegetables in relation to health. You can find the five base rules concerning a healthy diet over here.

Figure 5.2 Example of the flow to a computer tailored advice

used as starting point. The frequency of the use of this monitoring function is at the discretion of the participant. After 12 months the progress will be evaluated and communicated as part of the intervention. See Figure 5.3 for an example of a progress chart.

Personal Coach

The third critical feature of the Portal is a personal coach who will give continuous feedback and support through monthly e-mails. As like the monitoring function, this feature is part of the Health Portal to increase adherence to the intervention programme and to motivate participants to comply with the lifestyle recommendations and/or to maintain a healthy lifestyle. A previous study found promising results of individualized, interactive support for behaviour change on lifestyle.[27]

Physical activity	monday	tuesday	wednesday	thursday	friday	saturday	sunday
Moderate intensity	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes
Sports	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes	__ minutes

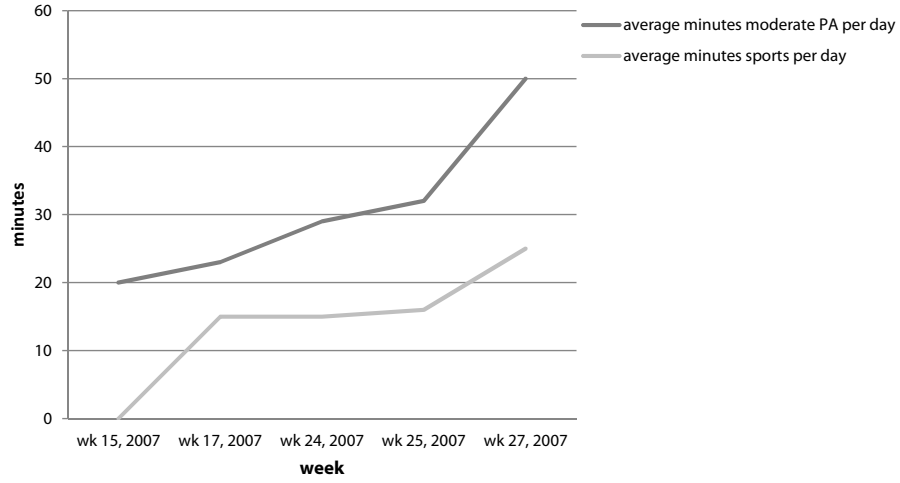


Figure 5.3 Example of the flow to a progress chart (monitoring function)

Three groups of participants will be distinguished, based on Health Portal use and lifestyle. First, participants who do meet the recommendations on PA and/or fruit and vegetable intake at baseline will receive automatically generated e-mails with support to maintain their healthy lifestyle. Second, those not meeting the recommendation and not using the Health Portal will receive a reminder, a single question whether they have changed their behaviour and an invitation to use the monitoring function. Last, participants who use the monitoring function, but did not meet the recommendation at baseline, will receive a personal, not automatically generated, e-mail with feedback on the data imported in the monitor.

If the participant does not want to receive the monthly e-mails, he can indicate this on the Health Portal.

Contact with professionals

The fourth feature is the opportunity to seek personal advice from a variety of professionals. By sending a message via the Health Portal participants can consult several experts such as a personal coach, a physiotherapist, or a dietician. This function is added to the Portal to increase adherence to the intervention programme.

The complete Health Portal will be offered for 12 months. After 12 months the monthly contact by a personal coach will be terminated, but access to the Portal will remain throughout the project.

MEASUREMENTS

Primary outcomes

Physical activity

PA level will be assessed by the self-administered short version of the International Physical Activity Questionnaire (IPAQ).[28] The IPAQ consists of seven open-ended questions providing information on the time spent on walking, moderate- and vigorous intensity activities and in sitting in the past seven days. Participants will be instructed to refer to all domains of PA. Frequency per week and duration per day spent on the specific activity will be assessed. Concerning sitting, only duration per day will be assessed.

Both categorical and continuous indicators of PA will be calculated. By multiplying the metabolic-equivalent (MET) intensity for each activity with the weekly duration (in minutes) spent on each activity, the continuous measure (MET-minutes per week) will be calculated as recommended in the IPAQ scoring protocol.[28] The Dutch national guideline for PA stipulates that an adult should engage in PA of at least moderate intensity for at least 30 minutes a day on five days a week, and preferably every day.[3] As a categorical measure, compliance with the recommended amount of PA is defined by spending a total of at least 150 minutes on walking, moderate-intensity and vigorous-intensity PA per week.[29] In addition, compliance with the recommendation of vigorous PA will be assessed by examining if one does engage in vigorous PA on at least 3 days a week for at least 20 minutes on these days.

Fruit and vegetables

Fruit and vegetable intake will be assessed by means of a self-administered nine-item validated Dutch Food Frequency Questionnaire.[30] The questionnaire consists of seven items on fruit consumption and two items on vegetable consumption. First, participants will be asked to indicate on how many days during the last month they ate or drank the most often consumed fruit and vegetables in the Netherlands (i.e. apples, citrus fruit, cooked vegetables, etc.). Answer categories vary from 'never or less than once a month' to '7 days a week'. For all answers except 'never or less than once a month' a closed question follows in which one is asked to indicate the number of serving spoons, pieces, or units of juice consumed on such a day. Total fruit consumption and total vegetable consumption will be calculated in grams. The total scores will also be used to determine compliance with the recommendations of an average of 200 grams of fruit and 200 grams of vegetables a day.

Secondary outcomes

Self-efficacy

Self-efficacy concerning PA and fruit and vegetable intake will be determined by asking how confident participants are to engage in PA and fruit and vegetable consumption in the next month, rated on a Likert scale between 1 (certainly) and 5 (certainly not).[31]

Perceived barriers

Perceived barriers concerning PA and fruit and vegetable intake will be assessed, by asking for the most important barrier to engage in these behaviours. The question on barriers to engage in PA has the following answer categories: not enough time/too busy, do not enjoy sports, too expensive, tired, fear of injury, no facilities at home, no facilities in direct environment, lack of a partner to exercise with, health problems, unsafe environment, and no barriers. The question on barriers concerning fruit and vegetable intake has the following categories: not enough time/too busy, not tasty, too expensive, no facilities at work to buy fruit and/or vegetables, no availability in the shops in the home environment, and no barriers.

Fat intake

Fat intake will be assessed by means of a self-administered 35-item validated Fat list covering 19 (groups of) food products. Participants will be asked about the frequency of food items during the last month with fixed categories. For each of the 19 categories a fat score, ranging from 0 (lowest fat intake) to a maximum varying from 3 to 5 points (highest fat intake), will be determined. Scores on the Fat list are presented in points instead of grams of fat, as only the most important saturated fat sources were included in the questionnaire.[32] A total fat score (range 0–80) will be calculated by adding up the 19 category fat scores.

Cardiovascular risk profile and physical fitness

The risk profile for cardiovascular events will be assessed by the SCORE (Systematic Coronary Risk Evaluation) system, taking into account the following risk factors: sex, age, smoking, total cholesterol level, and systolic blood pressure.[33] Sex, age, and smoking will be assessed by questionnaire. During a health check total blood cholesterol level will be determined in non-fasting blood through a finger prick (Accutrend GC, Roche Company, Mannheim, Germany). Systolic blood pressure will be measured with a fully automated sphygmomanometer (Omron M4-I, Omron HealthCare Europe BV, Hoofddorp, the Netherlands). With this sphygmomanometer resting heart rate will be measured as well.

In addition to these measures length and body weight will be measured to determine BMI (kg/m^2). Waist circumference and thickness of three skin folds (i.e. men: pectoralis major, abdomen, quadriceps; women: triceps, crista iliaca, quadriceps) will be measured to calculate body fat percentage.

A submaximal exercise test on a bicycle ergometer will be conducted to predict maximal oxygen uptake, according to the American College of Sports Medicine's (ACSM) protocol, using three-minutes stages and terminates at approximately 80% of the age predicted maximum heart rate. The initial test workload will depend on age, sex, and exercise status. The maximum number of workload stages is four, and the minimum test time is nine minutes. Participants will be asked to pedal with a frequency of 60 revolutions per minute (rpm). During the test, heart rate will be recorded, and used to predict maximal oxygen uptake (Vo_2max). All the physical measurements will be done according to the guidelines for exercise testing of the ACSM.[34]

Confounding variables

Possible confounders include demographics, smoking behaviour, and general health. The demographic variables of importance are age, ethnicity, educational level, sex, and marital status. Smoking is defined as current smoking status. General health will be assessed using the Short Form-12 questionnaire.[35] In addition, some questions on occupation will be asked: job title, years in current job, days and hours of work (including overtime work), main job requirements (physical or mental), and working conditions.[36] During a worksite visit, environmental determinants will be assessed, especially available resources in the company to provide and sustain healthy behaviour (e.g. fitness room, financial compensation for membership of sport/fitness club, stairs, fruit and vegetables in canteen). Further, participants will be asked if they have Internet availability at home.

Process evaluation

Participation

In the non-response analysis the following characteristics of (non)participants will be considered: age, sex, education, job title. In addition, enterprise size (number of employees) and history of health promotion activities in the company will be considered.

Adherence and Sustainability

Adherence to the intervention programme will be analysed in relation to compliance with lifestyle recommendations on PA and on fruit and vegetable intake, and in relation to sustainability of a healthy lifestyle. As markers of adherence to the intervention programme, the frequency of visiting the Health Portal, duration of stay on the Portal and frequency of contacts with professionals and personal coach will be registered. This will be done for the full Health Portal, as well as separately for the different parts of the Health Portal.

In addition, characteristics of participants (demographic variables, lifestyle at baseline, job, social support from colleagues and friends, and Internet availability at home) will be analysed as to subgroups with the best adherence to the intervention programme, compliance with the lifestyle recommendations, and sustainability of a healthy lifestyle.

Cost-effectiveness evaluation

The cost-effectiveness analysis will be performed from a societal perspective as well as a company perspective. The following direct costs will be determined: cost price of the standard WHPP, costs for the Health Portal and direct costs of medical consumption. Direct costs of medical consumption will be based on frequency of contacts with a variety of health professionals and average remuneration fee, assessed by an adapted version of the Dutch Trimbos and iMTA Questionnaire on Costs Associated with Psychiatric Illness (TiC-P).[37] The direct costs will be measured over the complete follow-up period of 24 months with annual questionnaires with 12-month recall.

The indirect costs will be based on assessment of days with loss of productivity at work due to health problems and productivity loss due to sickness absence, using the Dutch productivity and disease questionnaire (PRODISQ).[38] The estimated days of productivity loss will be multiplied by the average wage per day for each worksite.

In a second step cost-effectiveness ratios will be calculated on two measures of health: general health and the SCORE risk profile for cardiovascular events.

Sensitivity analysis

The sensitivity analysis will start with the analysis of the effectiveness of the intervention in specific subgroups, most notably those workers with a low physical activity level, with a low intake of vegetables and fruit, and with a high body mass index. A sensitivity analysis will also be performed on the individual cost-effectiveness ratios by means of bootstrapping. This part of the sensitivity analysis will be used to determine the minimum level of effectiveness required to make the Health Portal more cost-effective than the standard WHPP.

Sample size

The assumptions for the power calculations were: an intra-cluster correlation of 0.05 (as observed in a previous cluster RCT in companies),[39] an average of 20 workers per cluster, a power of 80%, and a level of significance of 5% (one-sided). Under these assumptions, we anticipate to be able to detect a difference of at least 12% in prevalence between intervention and control group (e.g. primary outcome measure 30% compliance with the recommendation for PA up to 42%) with 350 workers with completed questionnaires assigned to the intervention. Without a noticeable intra-cluster variance the detectable difference will increase by 9%. With an initial participation of 70% and loss-to-follow-up of 30%, the cluster RCT should invite 2*700 workers.

Statistical analyses

An intention-to-treat analysis will be used with last available information carried forward to missing data in subsequent measurements. A multilevel linear regression model with repeated measurements will be used (SAS proc Mixed) for continuous outcomes and a hier-

archical logistic regression (SAS proc Genmod) for dichotomous outcomes. The effect of self-efficacy, environmental determinants, Portal use, and drop-out during follow-up on primary and secondary outcome measures will be evaluated for their potentially differential effects.

Although the discriminatory power will be limited, an analysis will be carried out as to which subgroups participate in the WHPP and the Health Portal and which subgroups have the best adherence to the lifestyle recommendations (age, sex, education, and ethnicity).

In addition, preliminary analyses will be performed for will be performed for workers with cardiovascular complaints and workers with obesity in order to evaluate whether these subgroups are more or less amendable to changing their lifestyle.

DISCUSSION

In this study protocol the design of a pragmatic cluster randomized controlled trial on worksite health promotion is presented. The study is designed to evaluate the (cost)effectiveness of an individually tailored long-term worksite health promotion programme on PA and nutrition. It is hypothesized that the unique combination of critical features (a computer-tailored advice, a monitor function, a personal coach, and the opportunity to contact professionals at request) counteracts the main factors for ineffective WHPP (lack of participation, adherence to the WHPP and sustainability), and leads to a change in lifestyle. By conducting an extensive process evaluation we gain insight into the effective elements of worksite health promotion. By registering several process variables it is possible to find out if participants with a higher adherence to the (separate parts of the) WHPP are more likely to comply with the lifestyle recommendations.

With the health check as starting point for the WHPP, it is aimed to increase participation. The Health Portal's critical features are aimed to counteract loss to follow-up, and increase adherence to the intervention programme, compliance with lifestyle recommendations, and sustainability of a healthy lifestyle. Because of the long-term follow-up, sustainability of healthy behaviour will be facilitated.

The cost-effectiveness of the extensive Health Portal will be compared to the cost-effectiveness of the standard WHPP.

In conclusion, this study evaluates a promising intervention on healthy behaviour and results will provide insight into cost-effectiveness and the effective elements of WHPP.

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6

Moral issues in workplace health promotion

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ABSTRACT

Purpose There is debate to what extent employers are entitled to interfere with the lifestyle and health of their workers. In this context, little information is available on the opinion of employees. Within the framework of a workplace health promotion (WHP) programme, moral considerations among workers were investigated.

Methods Employees from five companies were invited to participate in a WHP programme. Both participants (n=513) and non-participants (n=205) in the programme filled out a questionnaire on individual characteristics, lifestyle, health, and opinions regarding WHP.

Results Nineteen per cent of the non-participants did not participate in the WHP programme because they prefer to arrange it themselves, and 13% (also) preferred to keep private life and work separate. More participants (87%) than non-participants (77%) agreed with the statement that it is good that employers try to improve employees' health (χ^2=12.78, p=0.002), and 26% of the non-participants and 21% of the participants think employer interference with their health is a violation of their privacy. Employees aged 50 year and older were more likely to agree with the latter statement than younger workers (OR=1.56, 95% CI 1.02–2.39).

Conclusion This study showed that most employees support the importance of WHP, but in a modest group of employees, moral considerations may play a role in their decision whether or not to participate in WHP. Older workers were more likely to resist employer interference with their health. Therefore, special attention on such moral considerations may be needed in the communication, design, and implementation of workplace health promotion programmes.

INTRODUCTION

Health promotion is a cornerstone of public health policy in most western countries. In order to reach as many individuals as possible, different settings are explored to provide health promotion programmes. Because of the possibility to reach large groups, and the presence of a natural social network, the workplace is regarded as a promising context for health promotion. The World Health Organization (WHO) has described the workplace as one of the priority settings for health promotion into the 21st century,[1] and the World Health Assembly of the WHO endorsed the "Workers' health: Global Plan of Action", aimed to protect and promote health at the workplace.[2] Workplace health promotion (WHP) is defined as the combined efforts of employers, employees, and society to improve the health and wellbeing of people at work. The European Agency for Safety and Health at Work (2010) describes that WHP should be achieved by promoting the participation of workers in the whole process of WHP.[3] Employers are encouraged to provide health promotion activities to their employees. With the aim to become the worlds' healthiest country in 2020, Australia gives workplaces a key role in preventative health.[4]

Individual health risk assessments and health risk reduction programmes aimed at lifestyle are popular applications for WHP (for example [5-6]). However, the participation in such programmes varies considerably between companies and is often low.[7] Why are participation levels so low in these kinds of WHP? Do moral considerations regarding lifestyle interference play a role in the low participation levels? Rothstein and Harrell (2009) have argued that although many programmes are partly justified by beneficence, the method of implementation may raise concerns about employer paternalism by overriding employee autonomy, and with the potential invasion of privacy.[8] Already in 1986, Allegrantte and Sloan discussed how workplace health promotion may pose ethical problems.[9] In 1987, Gordon presented her doubts on health promotion at the workplace and described that trust is an essential ingredient for successful health promotion.[10] The debate still continues to what extent employers are entitled to interfere with the lifestyle and health of their workers. Where does undue interference begin? In this context, little information is available on the opinion of employees regarding WHP. Within the framework of a WHP programme, we have investigated moral considerations among workers in relation to WHP offered by their employer.

METHODS

Study design and population

The study is embedded in a larger study in which we investigated the effectiveness of a WHP programme consisting of a physical health check with subsequent advice, and a website with general information, individualized advice and for the intervention group possibilities to ask questions and to monitor their own behaviour. An extensive description of the study proto-

col is published elsewhere.[11] Employees working in six companies from different branches were invited to participate in the study. Participants received a questionnaire asking for individual characteristics, lifestyle, and health. A sample of 860 non-participants in the health care organizations (n=2) and all non-participants in the commercial services organizations (n=2) and in the executive branch of government (n=1) received an abbreviated version of the questionnaire. In the other organization in the executive branch of government (n=1), non-respondents were not invited to fill out the questionnaire because the programme was initiated in the holiday period and communicated in a very limited way, and only 200 workers were allowed to participate. Therefore, most workers in that organization were unaware of the programme. Due to privacy regulations, the questionnaire was send out only once without any reminders. In total, 213 employees out of 860 non-participants responded (24.8%).

Moral considerations

Non-participants were asked why they did not participate, with multiple responses possible. In addition, both participants and non-participants were asked to indicate on a 5-point scale ranging from 'totally disagree' to 'totally agree' to what extent they agree with five statements addressing their opinion on WHP (Table 6.1).

Table 6.1 Answers of participants (P) and non-participants (NP) on five statements addressing their opinion on WHP.

	Disagree (%)		Neutral (%)		Agree (%)	
Statement	P	NP	P	NP	P	NP
1 A healthy lifestyle is important for me	2.1	1.0	8.0	7.7	89.9	91.3
2 My lifestyle is a personal matter	13.1	11.7	16.4	23.4	70.6	64.9
3 It is good that the employer tries to improve the health of the employees	2.9	3.4	10.1	19.9	86.9	76.7
4 It is good to stimulate colleagues to a healthy lifestyle	8.0	10.7	33.7	34.1	58.3	55.1
5 Employer interference with my health is a violation of my privacy	45.6	38.0	33.5	36.1	20.9	25.9

Additional information

In the questionnaire, participants were asked about age, sex, educational level, ethnicity, lifestyle, and health. Educational level was assessed as the highest level of education completed and was categorized into low (primary school, lower and intermediate secondary schooling, or lower vocational training), intermediate (higher secondary schooling or intermediate vocational schooling), and high (higher vocational schooling or university). We applied the standard definition of ethnicity of Statistics Netherlands and considered a person to be non-Dutch if at least one parent was born abroad.[12]

Lifestyle behaviours (physical activity, smoking, and alcohol intake) were dichotomized indicating whether they engaged in sufficient physical activity (at least 30 minutes of moderate to vigorous physical activity each day),[13] they currently smoked, and they had excessive alcohol consumption (at least six glasses on the same occasion at least once a week). Body

mass index (BMI) was measured by asking for weight and height and classified as normal weight (BMI<25 kg/m^2), overweight (25≤BMI<30 kg/m^2), or obese (BMI ≥30 kg/m^2). Self-perceived health was dichotomized into 'poor or moderate' and 'good to excellent'.[14]

Statistical analyses

The opinion of participants and non-participants regarding WHP was compared with a chi-square test. Logistic regression analyses were used to analyse the relation between individual characteristics and health-related factors with having problems with employer interference concerning employees' health. All analyses were adjusted for company.

RESULTS

In total, 513 participants and 205 non-participants were included in the analyses. Table 6.2 shows the characteristics of the study population.

Why do employees not participate in workplace health promotion?

Most non-participants gave 'I am healthy' (41%) as their reason for not participating in the programme, followed by practical reasons such as a lack of time, forgotten, or did not know about the programme (27%). Nine per cent of the non-participants did not participate because they are currently in treatment for health problems. However, a modest group of non-participants did seem to have objections to health promotion in the workplace setting, arguing they would like to keep private life and work separated (13%). Two per cent thinks it is not the employers' task to offer health promotion programmes, and 6% is concerned that their results may be made known to their employer or colleagues. Almost one-fifth of the non-participants preferred to arrange a lifestyle promotion programme themselves (19%), what might also be related to moral considerations, e.g., the view that both spheres should be kept separated.

Role of moral issues in workplace health promotion

Almost all participants and non-participants found a healthy lifestyle important (90%) (Table 6.1). Most participants (71%) and non-participants (65%) agreed with the second statement that their lifestyle is a personal matter. However, this did not lead to many concerns regarding the WHP. Actually, the majority of both participants and non-participants agreed that it is good that the employer tries to improve employees' health. However, we observed more participants (87%) than non-participants (77%) agreeing with the latter statement (χ^2=12.78, p=0.002). A small majority of the participants (58%) and non-participants (55%) agreed that it is good to stimulate colleagues to a healthy lifestyle, and more than a fourth of the non-participants (26%) and 21% of the participants agreed with the last statement that employer interference with their health is a violation of privacy. Particularly, employees who find lifestyle a personal

matter feel that employer interference with their health is a violation of privacy (27.9% vs. 7.7% who disagree with the second statement, χ^2=73.85, *p*=0.000). Non-participants who did not participate because of reasons that might be related to moral considerations (e.g., keep private life and work separated, not the employers' task to offer health promotion programmes, concerns that their results will be made known to their employer or colleagues, preference to arrange a lifestyle promotion programme themselves) were more likely to think that employer interference with their health is a violation of privacy (OR=2.20, 95% CI 1.12–4.32).

Who are the employees having problems with employer interference with employees' health?

As shown in Table 6.2, the reluctance against employer interference was in our study population not statistically significantly associated with an unhealthy lifestyle or a poor health. Older workers were more likely to resist employer interference with their health (OR=1.56, 95% CI 1.02–2.39). This was particularly the case among older non-participants.

Table 6.2 Characteristics of the study population and associations between demographics, lifestyle and health factors with agreeing with the statement 'employer interference with my health is a violation of my privacy' among participants and non-participants of a workplace health promotion program (n=718)

		Study population		Univariate analyses	
		n	%	OR	95% CI
Demographics					
Male gender		285	39.8	0.81	0.54-1.21
Age	<40 year	281	39.4	1.00	.
	40-49 year	204	28.6	1.11	0.71-1.75
	≥50 year	229	32.1	1.56*	1.02-2.39
Education	High	378	52.9	1.00	.
	Moderate	209	29.3	1.52	0.93-2.48
	Low	127	17.8	1.08	0.71-1.64
Non-Dutch ethnicity		115	16.0	0.81	0.49-1.35
Lifestyle and health factors					
BMI[1]	<25 kg/m^2	416	60.6	1.00	.
	25≤ BMI <30 kg/m^2	229	33.4	1.35	0.91-2.02
	≥30 kg/m^2	41	6.0	1.54	0.74-3.23
Insufficient physical activity		214	30.4	1.43	0.98-2.08
Current smoker		103	14.5	1.14	0.69-1.86
Excessive alcohol consumption		20	2.8	1.08	0.35-3.37
Poor/moderate perceived health		52	7.2	1.39	0.74-2.62

* p <0.05, all adjusted for company. [1] n =686

DISCUSSION

The importance of health promotion in the workplace setting is supported by employees. Although the most important reason for non-participation did not include moral issues, a modest group argued they would like to keep private life and work separated or preferred to arrange participation in a programme themselves and not via their employer. Both participants and non-participants in the workplace health promotion programme find a healthy lifestyle important, and most employees think it is good that the employer tries to improve the employees' health. Lifestyle and health factors do not play a major role in having reluctance against employer interference with employee health, but older workers are more likely to resist employer interference.

Reasons for non-participation are partly based on convictions that stress the value of keeping private life and work separate. More evidence is needed on the relation between moral considerations and participation in other health promotion programmes in the workplace setting. For instance, an important question is how to organize WHP in such a way that employer interference with the health of employees does not conflict with moral values, especially in older workers. In previous studies, higher participation in workplace health promotion was found when a more comprehensive approach was applied, integrating health promotion with occupation health.[15] Such comprehensive approach, not only focusing at the individuals and their lifestyle, but also at the work environment, might reduce potential concerns. Integrated workplace health promotion, focusing on both lifestyle and work factors, fits the concept of shared responsibility, in which both the employee and the employer are expected to take action to stay in good health. Furthermore, involvement of employees in the design and implementation of WHP may be important aspects to reduce possible barriers in participation. It has been noted that a participatory approach with active engagement of employees might be necessary for the success of a health promotion programme.[16] In ergonomics, a participatory approach has been shown to be successful,[17] and also in health promotion frameworks, a participatory approach is recommended (e.g., linkage system in intervention mapping).[18] A combination of a participatory approach and supervisor support might also enhance social support and subjective norms, which are important constructs in several social cognitive models (e.g., theory of planned behaviour).[19]

Although moral issues seem to play a modest role in the decision to participate or not in a WHP programme, there are employees with concerns about the role of the employer and the possible violation of privacy. The age difference in having reluctance against employer interference deserves further attention. In a systematic review, no difference in participation in WHP was found between younger and older workers.[7] However, for older workers, the situation of health checks and the focus on lifestyle in the work setting may be new, while the younger workers have never known otherwise. When WHP is aimed at keeping an ageing workforce healthy, special attention is needed to content and delivery of WHP and involve-

ment of older workers in design and implementation may support better acceptance and participation. Although not statistically significant, all associations between lifestyle factors and agreeing with the statement that employer interference with employees' health is a violation of privacy were in the same direction, indicating that workers with an unhealthy lifestyle or poor health are more likely to have reluctance against this employer interference. This may be related with the potential danger of 'blaming the victim'. Although it was communicated that all information would not be reported to their supervisor or employer, employees with an unhealthy lifestyle may fear potential consequences of participation.

Several studies showed that health promotion in the workplace setting might have beneficial effects on employee lifestyle and health, as well as on reducing sick leave.[20-21] Therefore, both employee and employer might benefit from WHP. However, our results suggest that moral considerations toward health promotion programme at the workplace should not be neglected and in the communication, design, and implementation of a programme deserve special attention.

The main limitation in this study was the low response among non-participants, which might induce selection bias. As described in the 'Methods', due to privacy regulations, we only send out the questionnaire once without any reminders. Furthermore, it should be noted that the design and implementation of WHP across companies and countries will differ, and opinions of employees concerning employer involvement may also differ between cultures and countries. More research on this topic is needed in order to get insight into their potential influence on the effectiveness of WHP.

This study showed that employees support the importance of health promotion in the workplace setting, but in a modest group of employees, moral considerations may play a role in their decision not to participate in workplace health promotion. Older workers were more likely to resist employer interference with their health. Therefore, special attention on such moral considerations may be needed in the communication, design, and implementation of workplace health promotion programmes.

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7

Demographic, behavioral and psychosocial correlates of using the website component of a worksite physical activity and healthy nutrition promotion program: a longitudinal study

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ABSTRACT

Background Internet-delivered behaviour change programmes have the potential to reach a large population. However, low participation levels and high levels of attrition are often observed. The worksite could be a setting suitable for reaching and retaining large numbers of people, but little is known about reach and use of Internet-delivered health promotion programmes in the worksite setting.

Objective This study aimed (1) to gain more insight in the use of the website component of a worksite behaviour change intervention and (2) to identify demographic, behavioural, and psychosocial factors associated with website use.

Methods The study was an observational study among participants from five workplaces in a cluster randomized controlled trial. At baseline, all participants visited a study website to fill out the baseline questionnaire. Then a physical health check was done followed by face-to-face advice. After this contact, all participants received an e-mail to promote visiting the website to view their health check results and the personal advice based on the baseline questionnaire. In the subsequent period, only participants in the intervention group received monthly e-mail messages to promote website visits and were offered additional Web-based tools (self-monitors and a food frequency questionnaire (FFQ) assessing saturated fat intake) to support their behaviour change. Website use was monitored by website statistics registering website access. Complete data were available for 726 employees. Logistic regression analyses were conducted to identify characteristics of employees who visited and used the website.

Results In total, 43% of the participants visited the website after the e-mail to promote website visits. Participants who were insufficiently physically active were less likely to visit the website (OR=0.63, 95% CI 0.45-0.88), whereas individuals with an elevated total cholesterol level visited the website more often (OR=1.44, 95% CI 1.05-1.98). The monthly e-mails in the intervention group resulted in higher website use during a 3-month period (18% versus 5% in the reference group; OR=3.96, 95% CI 2.30-6.82). Participants with a positive attitude toward increasing physical activity were less likely to visit the website (OR=0.54, 95% CI 0.31-0.93) or to use the self-monitor and FFQ (OR=0.50, 95% CI 0.25-0.99). Female workers visited the website more often to monitor their behaviour and to receive advice on fat intake (OR=2.36, 95% CI 1.14-4.90).

Conclusions Almost half of the participants used the website component of a worksite behaviour change programme. Monthly e-mails were a prompt to visit the website, but website use remained low. More women than men used the website to obtain personalized advice for behaviour change. No consistently higher participation was found among those with healthier behaviours. This health promotion programme did not provide an indication that healthier subjects are more susceptible to health promotion.

INTRODUCTION

There are indications that Internet-delivered interventions may be effective in improving physical activity, healthy nutrition, and weight reduction.[1-5] Internet-delivered programmes have the potential to reach a large population at relatively low costs. However, low participation and high levels of attrition are often observed in those programmes.[5-8] These rates are of concern since studies with a higher utilization tend to have better behaviour change outcomes.[5] The RE-AIM framework stresses the importance of evaluating the reach and representativeness of programme participants,[9] and Eysenbach[6] and Danaher and colleagues[10] have emphasized the need to address process measures in addition to the effectiveness of Internet-delivered programmes. The worksite has been identified as a promising setting to reach large numbers of people in a natural social network, which may increase participation.[11-12] However, the reach and use of Internet-delivered programmes in the worksite setting are largely unknown.

In contrast with the high levels of attrition in the general population, Ware and colleagues studied an intervention consisting of an Internet-delivered programme at the worksite with an initial face-to-face contact and found a repeated participation over a 12-week period of 69%.[13] Several studies on Internet-delivered behaviour change programmes suggested that women, people who are more highly educated, and people with positive health behaviours participate more often in Internet-delivered health promotion programmes compared with the general population.[8,14-16] However, there are also studies indicating that Internet-delivered programmes have attracted individuals who would benefit most from them, that is, participants who are overweight.[8,13,16] It has also been suggested that the provision of regular new content and the possibility to monitor progress toward behaviour change could be important factors in encouraging website use.[17-18] Furthermore, a recent review reported several studies with enhanced effectiveness after frequent e-mail prompts.[19]

It has been indicated that participants may not be ready to rely solely on Internet-delivered programmes.[5] The worksite setting, in which it is feasible to combine face-to-face contact and regular e-mails, may, therefore, be a good setting for the implementation of interventions. Therefore, we expect that providing an Internet-delivered lifestyle programme in the workplace setting with an initial face-to-face contact, a behaviour change monitor functionality, and monthly e-mail messages will enhance programme use.

More insight into these specific programme characteristics could provide information on ways to attract visitors to an Internet-delivered health promotion intervention and to keep them using the programme. The aim of the present study is to gain more insight into the use of a website component of a worksite intervention, in order to be able to identify factors related to website use and intervention components that may enhance use. Therefore, the present study investigates the demographic, behavioural, psychosocial, and health-related factors in relation to programme use in an Internet-delivered programme with a face-to-face contact at the worksite.

METHODS

Design, participants, and recruitment

An observational study was conducted from March 26, 2008 until February 9, 2009. Participants were employees from five different workplaces: two companies engaged in commercial services, two in health care, and one executive branch of government. The participants had enrolled in a two-year cluster randomized controlled trial in which the departments (n=64) within these five workplaces were the units of randomization. An extensive description of this larger worksite lifestyle promotion programme primarily aimed at physical activity and nutrition is described elsewhere.[20] The study was announced through e-mail, the company's intranet and/or a company magazine. In the two commercial services companies, all employees directly received an e-mail from a health management organization that had implemented the intervention in which employees were invited to visit the study website. For the other workplaces, interested employees could express their interest in participating in the study through e-mail. These three workplaces restricted the maximum number of participants in such a way that the first 200 (two workplaces) or 300 (one workplace) interested employees were allowed to participate. Participants enrolled in the study when they visited the website and completed the baseline questionnaire. Participation levels varied from 3% to 61% of all workers per workplace, with a median participation level of 10%. The number of participants per workplace ranged from 33 to 270 (median 175), and workplace sizes varied from 70 to more than 5000 employees (median 1706). Complete data on individual characteristics, behaviours, and health were available for 726 employees. The Medical Ethics Committee of Erasmus MC, University Medical Center in Rotterdam, the Netherlands, approved the study and all participants gave written informed consent.

Procedure

All participants visited the study website by using an individualized username and password to fill out the baseline questionnaire and to make an appointment for a physical health check (Figure 7.1). The health check took place at the workplace and consisted of measurement of height, weight, waist circumference, total cholesterol level, blood pressure, and a bicycle test to estimate maximum oxygen uptake. Immediately after the health check, all participants received an overview of their test results in print. These results were discussed with the participants, and each participant received advice on how to improve or maintain their lifestyle in a face-to-face contact. Participants who were pre-hypertensive or who had an elevated cholesterol level were advised to visit their general practitioner or the occupational physician. The physical health check took one hour, and workers were allowed to participate during their regular work hours. The test reports were also provided on the study website together with personal advice based on participants' answers on the baseline questionnaire. After all participants in one workplace had completed the health checks, all participants were

Figure 7.1 Screenshot of the website

invited through an e-mail message to visit the website to view their health check results and the personal advice based on the baseline questionnaire (see Figure 7.2, period 1). The personal advice provided on the website corresponded with the advice in the face-to-face contact and was provided in a structured and reproducible way.

Reference group

Participants in the reference group had access to their physical health results and reports based on the online questionnaire. These reports consisted of their personal physical activity level and fruit and vegetable intake level and information on the recommended levels. The website provided general lifestyle and health information.

Intervention group

Participants in the intervention group had access to several additional website functionalities compared with participants in the reference group. Participants in the intervention group received more extensive computer-tailored advice on their self-reported physical activity and nutrition behaviour on the questionnaire. The electronically generated advice included personal and action feedback taking into account perceived barriers for participants not meeting the guidelines.[20-21] Perceived barriers were assessed by asking for the most important barrier to engaging in the specific lifestyle behaviour.

In addition, participants had the opportunity to use the following intervention strategies: (1) online self-monitoring of fruit and vegetable intake, physical activity, and weight to monitor progress toward behaviour change and obtain tracking charts; (2) a food frequency

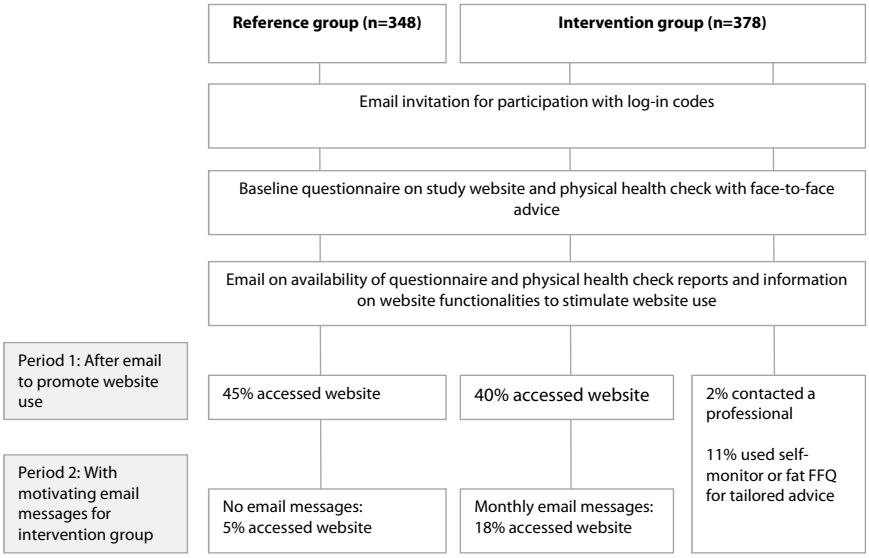

Figure 7.2 Study design with the two distinct periods for website use

questionnaire (FFQ) assessing saturated fat intake for tailored advice (after the third e-mail message);[22] and (3) the ability to ask questions of several professionals.

Finally, to stimulate sustained website use, participants in the intervention group received motivating monthly e-mail messages focusing on physical activity and nutrition. Participants received their first motivating e-mail message one month after they received an e-mail to visit the website to view their health check results and the advice based on the baseline questionnaire. With the motivating e-mail messages, the second important period of the website component started (see Figure 7.2, period 2). Period 2 covered three monthly e-mail messages focusing on physical activity and nutrition (duration of 12 weeks). The first monthly e-mail message was tailored to the individual, and if new information was available through the self-monitors, the subsequent e-mail was personalized again. If no new information from the participant was available, the e-mails contained more general information. The third message announced the opportunity to fill out the fat FFQ for tailored advice. In all monthly e-mail messages, participants were encouraged to fill out the self-monitors and to ask their questions. The monthly e-mail messages were written by a researcher (author SR).

Measurements

Website use

Participants had to log in to the website using their personal login details to access their individual reports as well as to read general information on health and lifestyle. All website visits were registered, and for both period 1 and period 2, a variable for website visit (yes/no) was calculated for all the participants. Website use in period 1 was determined as at least

1 website visit within the month after the e-mail was sent to promote website use. Website use in period 2 was determined as at least 1 website visit within three months after the first motivating monthly e-mail message to the intervention group. For participants in the intervention group, self-monitor use and fat FFQ use were defined as using these features at least once in period 1 or period 2.

Demographic characteristics

In the baseline questionnaire, participants were asked about age, sex, education, marital status, and ethnicity. Educational level was assessed as the highest level of education completed and was categorized into low (primary school, lower and intermediate secondary schooling, or lower vocational training), intermediate (higher secondary schooling or intermediate vocational schooling) and high (higher vocational schooling or university). We applied the standard definition of ethnicity of Statistics Netherlands and considered a person to be non-Dutch if at least one parent was born abroad.[23]

Lifestyle behaviour and health indicators

Physical activity level was measured in the baseline questionnaire using the self-administered short version of the International Physical Activity Questionnaire (IPAQ),[24] which assessed vigorous and moderate intensity physical activity. The average time spent on physical activity per day was calculated. For all behaviours we calculated a dichotomous variable for compliance or noncompliance with recommendations. For physical activity level, we used a cut-off point of 30 minutes or more per day. We did not include walking in this calculation since walking at a casual pace is regarded a light-intensity activity.[25] For fruit and vegetable intake, 400 grams of fruit and vegetable intake as measured with a self-administered nine-item validated Dutch Food Frequency Questionnaire was used as cut-off point.[26] Smoking was defined as current smoking status and excessive alcohol use as drinking at least six glasses on the same occasion at least once a week. The Short Form-12 (SF-12) questionnaire was used to measure self-reported general, physical, and mental health.[27] General health was dichotomized into 'poor or moderate' and 'good to excellent'. Physical and mental health was categorized as poor if the summed scores were in the lowest quartile (lower than 48.74 and 46.56, respectively).

Physical health check

In the physical health check, height and weight were measured to calculate body mass index (BMI) and to categorize individuals as normal weight (BMI<25 kg/m^2) or overweight (BMI ≥25 kg/m^2). Total blood cholesterol was measured in non-fasting blood through a finger prick (Accutrend GC, Roche Company, Mannheim, Germany), and blood pressure with a fully automated sphygmomanometer (Omron M4-I, Omron HealthCare Europe BV, Hoofddorp, the Netherlands). A total cholesterol level above 5.0 mmol/l and a systolic or diastolic blood

pressure above respectively 140 mmHg and 90 mmHg were considered elevated. A submaximal exercise test on a bicycle ergometer was conducted to predict maximal oxygen uptake according to the American College of Sports Medicine's (ACSM) protocol using their sex- and age-dependent cut-off points.[28]

Social cognitive variables

For physical activity and for fruit and vegetable intake, attitude, social support, self-efficacy, and intention to change were measured in the baseline questionnaire. Intention, self-efficacy, and attitude were measured on a 5-point Likert scale ranging from 'certainly not' to 'certainly'. All variables were dichotomized. Intention was measured by asking whether the participant intended to change the behaviour in the next month.[29] A high intention was defined as probably or certainly intending to change the behaviour. Self-efficacy was assessed by asking whether the participant was confident about engaging in the healthy behaviours in the next month.[29] High self-efficacy was defined as probably or certainly confident about changing the behaviour. To measure attitude, individuals were asked whether they thought improving the behaviour would take a lot of effort.[30] Those participants who answered 'probably not' or 'certainly not' were considered as having a positive attitude. Finally, social support was measured by asking whether family and friends support them in changing the specific behaviours. This was measured on a 4-point Likert scale ranging from 'seldom or never' to 'a lot'.[29] High social support was defined as perceiving 'pretty much' or 'a lot' support.

Statistical analyses

Descriptive statistics were used to present the baseline characteristics of the study population. The associations of demographic characteristics, behaviours, social cognitive variables, and health indicators with website use were investigated with logistic regression analysis. Separate analyses were conducted for website use in period 1 among the total study population and website use in period 2 among the intervention group. First, univariate logistic regression models were carried out to determine the single effects of the possible determinants. All variables with a p value less than 0.20 in the univariate models were considered for inclusion in the multivariate analysis. A backward regression method was used to determine the multivariate model. In the analyses, age and sex were included by default in each multivariate model. Variables with a p value of 0.05 or less were retained in the multivariate model. The results are presented as the odds ratios (OR) and corresponding 95% confidence intervals (95% CI), with odds ratios below and above 1 representing, respectively, lower and higher website use. All analyses were carried out with SPSS version 15.0 (SPSS Inc, Chicago, IL, USA).

RESULTS

Study population

In total, 726 employees participated in this study. The baseline characteristics of the study population are presented in Table 7.1. More than half of the participants (56%) were female workers. The mean age of the study population was 42 years, ranging from 20 to 63 years, and 47% had had higher education. Almost a third of the participants (31%) were not physically active at a moderate intensity for at least 30 minutes per day, and 45% had insufficient fruit and vegetable intake. Complying with the moderate intensity physical activity guideline was associated with sufficient fruit and vegetable intake (not in table). More than half of the participants who did not met the physical activity guideline for moderate intense physical activity had the intention to increase physical activity (55%), compared with 45% of the participants who did comply with the guideline. For fruit and vegetable intake, 22% of the participants who did not meet the recommendation and 13% of the participants who did, intended to increase fruit and vegetable intake. Participants complying with the guidelines were more likely to have a positive attitude. No association was found between self-efficacy and complying with the recommended levels for physical activity and fruit and vegetable intake (not in table).

Website visit

After the first e-mail message, 43% of all the participants visited the website component of the programme; 45% of the participants in the reference group and 40% in the intervention group (OR=0.82, 95% CI 0.61-1.10). In the following three months in which the intervention group received a monthly e-mail message, 18% of the participants in the intervention group visited the website again compared with 5% in the reference group (OR=3.96, 95% CI 2.30-6.82).

Correlates of website visit

As shown in the univariate analysis in Table 7.2, older employees (OR=1.89, 95% CI 1.15-3.13), those with a positive attitude toward increasing physical activity level (OR=1.36, 95% CI 1.01-1.83), and those with an elevated cholesterol level (OR=1.51, 95% CI 1.12-2.04) were more likely to visit the website after the first e-mail message, and participants with insufficient moderate-intensity physical activity (OR=0.66, 95% CI 0.47-0.91) were less likely to do so. In the multivariate analysis, sufficient moderate physical activity (OR=0.64, 95% CI 0.46-0.90 for insufficient physical activity) and an elevated cholesterol level (OR=1.44, 95% CI 1.05-1.98) remained significantly associated with website visit in period 1. Attitude to increase physical activity did not remain statistically significant in the multivariate analysis (OR=1.34, 95% CI 0.98-1.82). Table 7.3 shows that among the participants in the intervention group, those with a positive attitude toward increasing their level of physical activity (OR=0.57, 95%

CI 0.33-0.97) and fruit and vegetable intake (OR=0.55, 95% CI 0.32-0.96) were less likely to visit the website in the period with monthly e-mail messages. In the multivariate analysis, only attitude toward increasing physical activity level (OR=0.54, 95% CI 0.31-0.93) remained statistically significant.

Use of interactive website elements in the intervention condition

Of the website visitors in the intervention group, 11% used the self-monitors or the FFQ, and 2% contacted a professional via the website (Figure 7.2). Table 7.4 shows that female workers were more likely to use the self-monitor or fat FFQ compared with male workers (OR=2.36, 95% CI 1.14-4.90). As for website use in period 2, those workers with a positive attitude toward increasing their physical activity level were less likely to visit the website to use the specific website functionalities (OR=0.50, 95% CI 0.25-0.99).

Table 7.1 Baseline characteristics of the total study population and the intervention group in a longitudinal study among 726 employees

	Total study population (n = 726)		Intervention (n = 378)		Reference (n = 348)	
	n	%	n	%	n	%
Demographics						
Female gender	403	56%	209	55%	194	56%
Age (years)						
<30	100	14%	56	15%	44	13%
30-39	203	28%	94	25%	109	31%
40-49	228	31%	112	30%	116	33%
≥ 50	194	27%	115	31%	79	23%
Education level						
Low	131	18%	60	16%	71	20%
Intermediate	253	35%	131	35%	122	35%
High	341	47%	186	49%	155	45%
Dutch ethnicity	615	85%	319	85%	296	85%
Married/cohabiting	547	75%	285	76%	262	75%
Behaviour						
Insufficient moderate PA	223	31%	115	31%	108	31%
Insufficient vigorous PA	502	69%	258	68%	244	70%
Insufficient fruit or vegetable intake	323	45%	159	42%	164	47%
Smoking	117	16%	60	16%	57	17%
Excessive alcohol	27	4%	13	3%	14	4%
Social cognitive variables						
Physical activity						
Positive attitude	355	49%	197	52%	158	45%
High social support	112	15%	55	15%	57	16%
High self-efficacy	562	77%	288	76%	274	79%
Intention to increase PA	348	48%	167	44%	181	52%
Fruit and vegetable intake						
Positive attitude	510	70%	265	70%	245	71%
High social support	91	13%	46	12%	45	13%
High self-efficacy	599	83%	319	84%	280	81%
Intention to increase intake	124	17%	68	18%	56	16%
Health indicators						
BMI ≥25 kg/m²	293	40%	152	40%	141	41%
Poor/moderate general health	39	5%	17	5%	22	6%
Lowest quartile mental health	181	25%	97	26%	84	24%
Lowest quartile physical health	181	25%	90	24%	91	26%
Elevated blood pressure	217	30%	113	30%	104	30%
Elevated total cholesterol level	301	42%	161	43%	140	41%
Poor maximum oxygen uptake	90	13%	43	12%	47	15%

Table 7.2 Univariate and multivariate odds ratios and 95% confidence intervals of individual characteristics, behaviours, social cognitive variables, and health indicators for visiting the website in the first period after the health check (n=726)

	Univariate analysis		Multivariate analysis	
	OR	95% CI	OR	95% CI
Demographics				
Female gender	0.93	0.69-1.25	1.00	0.74-1.36
Age (years)				
<30	1.00	.	1.00	.
30-39	1.35	0.82-2.23	1.35	0.81-2.24
40-49	1.35	0.83-2.21	1.18	0.72-1.96
≥ 50	1.89*	1.15-3.13	1.65	0.97-2.79
Education level				
Low	0.92	0.62-1.39		
Intermediate	0.76[a]	0.55-1.06		
High	1.00	.		
Dutch ethnicity	0.96	0.64-1.45		
Married/cohabiting	1.34[a]	0.94-1.89		
Behaviour				
Insufficient moderate PA	0.66*	0.47-0.91	0.64*	0.46-0.90
Insufficient vigorous PA	1.01	0.73-1.39		
Insufficient fruit or vegetable intake	1.01	0.75-1.36		
Smoking	0.71[a]	0.47-1.07		
Excessive alcohol consumption	0.83	0.37-1.85		
Social cognitive variables				
Physical activity				
Positive attitude	1.36*	1.01-1.83		
High social support	0.84	0.55-1.27		
High self-efficacy	1.00	0.71-1.43		
Intention to increase PA	1.11	0.83-1.49		
Fruit and vegetable intake				
Positive attitude	1.22	0.88-1.69		
High social support	0.97	0.62-1.52		
High self-efficacy	0.89	0.60-1.31		
Intention to increase intake	0.70[a]	0.47-1.05		
Health indicators				
BMI ≥25 kg/m^2	0.96	0.71-1.30		
Poor/moderate general health	1.29	0.68-2.46		
Lowest quartile mental health	1.18	0.84-1.66		
Lowest quartile physical health	0.97	0.69-0.37		
Elevated blood pressure	0.82	0.59-1.13		
Elevated total cholesterol level	1.51*	1.12-2.04	1.44*	1.05-1.98
Poor maximum oxygen uptake	0.83	0.53-1.31		

* $p < 0.05$

[a] $p < 0.20$, considered for inclusion in the multivariate logistic regression analysis

Table 7.3 Characteristics of the intervention group and univariate and multivariate odds ratios and 95% confidence intervals of individual characteristics, behaviours, social cognitive variables, and health indicators for visiting the website in the second period in the intervention group (n=378)

	Univariate analysis		Multivariate analysis	
	OR	95% CI	OR	95% CI
Demographics				
Female gender	1.32	0.77-2.27	1.35	0.78-2.33
Age (years)				
<30	1.00	.	1.00	.
30-39	0.97	0.39-2.39	1.02	0.41-2.54
40-49	1.26	0.54-2.97	1.47	0.62-3.52
≥ 50	1.14	0.49-2.69	1.37	0.57-3.28
Education level				
Low	0.57	0.24-1.36		
Intermediate	1.04	0.59-1.84		
High	1.00	.		
Dutch ethnicity	1.05	0.50-2.20		
Married/cohabiting	1.01	0.54-1.87		
Behaviour				
Insufficient moderate PA	1.06	0.60-1.87		
Insufficient vigorous PA	0.86	0.49-1.51		
Insufficient fruit or vegetable intake	1.45[a]	0.85-2.46		
Smoking	0.46[a]	0.19-1.13		
Excessive alcohol consumption	0.41	0.05-3.24		
Social cognitive variables				
Physical activity				
Positive attitude	0.57*	0.33-0.97	0.54*	0.31-0.93
High social support	0.80	0.36-1.78		
High self-efficacy	0.83	0.45-1.51		
Intention to increase PA	1.11	0.65-1.89		
Fruit and vegetable intake				
Positive attitude	0.55*	0.32-0.96		
High social support	0.42[a]	0.14-1.20		
High self-efficacy	1.07	0.51-2.25		
Intention to increase intake	0.89	0.44-1.80		
Health indicators				
BMI ≥25 kg/m^2	1.27	0.75-2.17		
Poor/moderate general health	0.99	0.28-3.54		
Lowest quartile mental health	0.65[a]	0.34-1.24		
Lowest quartile physical health	1.01	0.55-1.89		
Elevated blood pressure	0.75	0.41-1.38		
Elevated total cholesterol level	0.89	0.52-1.52		
Poor maximum oxygen uptake	0.56	0.21-1.47		

[*] $p < 0.05$

[a] $p < 0.20$, considered for inclusion in the multivariate logistic regression analysis

Table 7.4 Univariate and multivariate odds ratios and 95% confidence intervals of individual characteristics, behaviours, social cognitive variables, and health indicators for self-monitor and fat FFQ use in the intervention group (n=378)

	Univariate analysis		Multivariate analysis	
	OR	95% CI	OR	95% CI
Demographics				
Female gender	2.41*	1.17-4.96	2.36*	1.14-4.90
Age (years)				
<30	1.00	.	1.00	.
30-39	0.93	0.34-2.55	0.99	0.36-2.77
40-49	0.92	0.35-2.45	1.09	0.40-2.98
≥ 50	0.67	0.24-1.86	0.85	0.30-2.43
Education level				
Low	0.87	0.34-2.28		
Intermediate	0.94	0.46-1.93		
High	1.00	.		
Dutch ethnicity	1.77	0.61-5.17		
Married/cohabiting	1.00	0.47-2.13		
Behaviour				
Insufficient moderate PA	1.21	0.61-2.40		
Insufficient vigorous PA	1.00	0.50-2.01		
Insufficient fruit & vegetable intake	1.69[a]	0.88-3.24		
Smoking	0.54	0.19-1.58		
Excessive alcohol consumption	0.68	0.09-5.35		
Social cognitive variables				
Physical activity				
Positive attitude	0.49*	0.25-0.96	0.50*	0.25-0.99
High social support	0.80	0.30-2.13		
High self-efficacy	0.73	0.36-1.49		
Intention to increase PA	1.37	0.72-2.63		
Fruit and vegetable intake				
Positive attitude	0.63[a]	0.32-1.24		
High social support	0.34[a]	0.08-1.46		
High self-efficacy	1.09	0.44-2.72		
Intention to increase intake	1.33	0.60-2.92		
Health indicators				
BMI ≥25 kg/m^2	0.94	0.48-1.83		
Poor/moderate general health	1.82	0.50-6.63		
Lowest quartile mental health	0.93	0.44-1.97		
Lowest quartile physical health	1.37	0.67-2.82		
Elevated blood pressure	0.45[a]	0.19-1.05		
Elevated total cholesterol level	1.06	0.55-2.03		
Poor maximum oxygen uptake	1.63	0.67-3.96		

* $p < 0.05$

[a] $p < 0.20$, considered for inclusion in the multivariate logistic regression analysis

DISCUSSION

In this study, we examined the use of the website component of a worksite physical activity and nutrition promotion programme. In total, 43% of the participants visited the website after an e-mail to promote website visits to view their personal health results and the personal advice based on the baseline questionnaire. Participants who did not meet the recommended level of physical activity were less likely to visit the website, whereas individuals with an elevated total cholesterol level were more likely to visit the website. Participants in the intervention group visited the website more often during a 3-month period than those in the reference group (18% versus 5%). Participants with a positive attitude toward increasing physical activity were less likely to use self-monitors for tracking their behaviour and to complete the fat FFQ to receive tailored advice. Compared with male workers, more female workers visited the website to monitor their behaviour and/or weight or to receive tailored advice on fat intake.

Website Visits

Compared to previous studies, website visiting after the first email reminder was relatively high.[6,8] The face-to-face contact may have had a positive influence and may be one of the reasons for the relatively high initial number of visitors. However, website use was not optimal, since it was intended that all participants would visit the website. By not using the website component, a substantial part of the study group was not exposed to the content provided on the website. Leslie and colleagues found in a study investigating a physical activity website in the workplace setting that a comparable 46% of the participating employees visited the website at least once.[31] There are studies, however, that have found higher levels of website usage. Ware and colleagues,[13] for example, found in a study with a face-to-face contact and an Internet-delivered physical activity and weight management program that 78% of the participants were still using the website after 12 weeks. An important difference between our study and the study of Ware and colleagues is the role of the initial contact. In our study, the face-to-face contact consisted of feedback of test results and personal advice, while in the study of Ware it was a screening and an information session on how to use the Internet-delivered program. One of the explanations for the lower usage level in our study may be that people participated in the study primarily to get insight into their health status (cholesterol level and blood pressure) and that they were less interested in changing their behaviour. The fact that participants could visit the website component after a series of tests and advice based on these tests in a face-to-face contact may have made it less relevant for them to visit the website to review their results and to obtain additional advice and information about a healthy lifestyle. Another explanation might be a lack of new content on the website. It has been suggested by experts as well as potential users that the provision of regular new content could be an important factor in encouraging website use.[17-18]

Correlates of website visits

Participants with an elevated cholesterol level were more likely to visit the website, which may indicate that visiting the website component was relevant for participants with less favourable test outcomes. In contrast, in the month after the e-mail to promote website use was sent, individuals meeting the physical activity guideline were more likely to visit the website. Verheijden and colleagues also reported contradictory findings,[8] with more participation among people with healthier lifestyles and among overweight or obese participants. It could be hypothesized that those with poorer outcomes on health indicators had a higher risk perception as compared with those not complying with lifestyle recommendations. However, elevated cholesterol level was the only health indicator associated with website use, and this finding was not corroborated by other health indicators such as blood pressure and self-reported health and, thus, the finding that elevated cholesterol level was associated with website use may be spurious. The finding that participants not meeting the physical activity guideline were less likely to use the website might be related to the communication to encourage the individual to change their behaviour. However, this lower website use was only found in the first period and not in the period with monthly e-mail messages. Based on our results, no consistent higher participation was found among those with healthier behaviours, and, thus, a health-based selection in website use could not be demonstrated.

Use of interactive website elements in the intervention condition

In line with other studies, we found that Internet access in the following three months was low.[5-8] Even though the three e-mail reminders sent in this period resulted in a higher percentage of website visits compared with the reference group; only 18% visited the website. The difference between the reference group and the intervention group provides evidence that monthly e-mail messages function as a prompt to visit the website; however, it may be a weak prompt. Ware and colleagues found a high repeated participation with an Internet-delivered programme using an accelerometer and weighing scale as monitoring devices.[13] The availability of such devices might increase compliance with the use of self-monitors. Experts have suggested that the possibility to monitor progress could be a factor to encourage website use.[17] In a focus group, study participants mentioned that the possibility of asking questions on a website for behaviour change would increase use.[32] However, the findings of our study do not seem to support these notions. We do not know, however, why participants visited the website again in the three month period. Additional qualitative information of website use may shed more light on this in future studies.

Participants with a positive attitude (i.e., those who thought that it would not take a lot of effort to increase physical activity and fruit and vegetables intake) were less likely to track their behaviour or to obtain tailored advice on fat intake. This may indicate that they did not need the website component to visit it again. Whereas women and men did not differ with respect to website visits, more women used the website to track their behaviour or to

obtain tailored advice on fat intake. In a systematic review on participation in worksite health promotion programmes, a higher initial participation among female workers was found except for programmes offering access to a fitness centre.[33] Other studies have also reported a higher participation among women in Internet-delivered programmes.[2,8,34] This may be explained by a higher interest in health issues among women.[14]

Limitations

This study has some limitations. First, two measures of website use are reported: website access and the use of a self-monitor and a fat questionnaire to obtain tailored advice. These measures do not provide any information as to what extent the participants actually read the available information or how much time they spent on the website. Second, because of the combination of the website component with a face-to-face contact, we cannot generalize the results to website use of programmes without face-to-face contact in the worksite settings. Third, departments within workplaces instead of individuals or workplaces were randomized. Since employees do not share their workspace with employees from other departments, we do not think contamination was a major issue in our study. Furthermore, the programmes for the intervention and reference groups were quite similar, with both groups having the opportunity to participate in a face-to-face contact and to use the website. Therefore, it would be difficult for a participant to find out that different programmes were offered. Fourth, the participation levels as well as the populations of the participating workplaces differed. Not all employees had equivalent access and use of computers and e-mail during their workday. Therefore, we estimated for all occupations in the study population if the work is primarily done using a computer. The group spending a major part of the day with computer work was not found to have an increased website use compared with workers with less or no computer work. Strengths of the study were that the user statistics are linked to the individual level and the availability of objective health indicators.

Conclusion

This study demonstrated that almost half of the participants used the website component of a worksite physical activity and healthy nutrition promotion programme in the period after a face-to-face contact with personal advice. Monthly e-mail messages were a prompt to visit the website. However, over the longer term, low use was found in this target group. More women than men used the website to obtain personalized advice for behaviour change. No consistent higher participation was found among those with healthier behaviours. This health promotion programme did not provide an indication that healthier subjects are more susceptible to health promotion.

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8

Initial and sustained participation in an Internet-delivered long-term worksite health promotion program on physical activity and nutrition

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Submitted

ABSTRACT

Background Determinants of participation in health promotion are largely unknown. For the evaluation and implementation of interventions, information is needed about who is reached and who uses behaviour change programmes.

Objective In this study individual, lifestyle and health indicators are investigated in relation with initial and sustained participation in an Internet-delivered physical activity and healthy nutrition programme in the workplace setting. In addition, determinants of website use are studied.

Methods Determinants of participation were investigated in a longitudinal study among participants from six workplaces in a two-year cluster randomized controlled trial. At baseline, all participants visited a study website to fill out the baseline questionnaire. Subsequently, a physical health check was offered followed by face-to-face advice. All participants had access to a website with information on lifestyle and health, and personal feedback on the questionnaire results throughout the study period. Participants in the intervention received monthly e-mail messages to promote website visits during the first year as well as additional Web-based tools (self-monitors and a food frequency questionnaire assessing saturated fat intake) to support behaviour change. Website use was monitored by website statistics on access. Logistic regression analyses were conducted to identify characteristics of employees who participated in the programme and used the website.

Results Complete baseline data were available for 924 employees. Employees aged 30 years and older were more likely to start with the programme, and to sustain their participation. Workers with a low intention to increase their physical activity level were less likely to participate (OR=0.60, 95% CI 0.43-0.85), but more likely to sustain participating throughout the study period (ORs ranging from 1.40 to 2.06). Smokers were less likely to sustain their participation (OR=0.52, 95% CI 0.33-0.82) and to visit the website (OR=0.72, 95% CI 0.54-0.96). Website use was highest in the periods immediately after the baseline (73%) and follow-up questionnaires (71% and 87%). Employees in the intervention were more likely to visit the website in the period they received monthly e-mails compared with participants in the control condition (OR=5.88, 95% CI 3.75-9.20), but less likely to visit the website in the subsequent period (OR=0.62, 95% CI 0.45-0.85).

Conclusions Modest initial participation and high attrition in programme use were found. Workers with a low intention to change their behaviour were less likely to start to participate, but once participating they were more likely to sustain their participation. Lifestyle and health indicators were not related with initial participation, but those with an unhealthier lifestyle were less likely to sustain. This might influence programme effectiveness. Regular e-mail messages prompted website use, but the use of important intervention characteristics was limited. There is a need for more appealing techniques to enhance retention and to keep those individuals who need it most attracted to the programme.

INTRODUCTION

Low participation is a concern in health promotion programmes.[1] The workplace had been thought of as a promising setting for health promotion, with an ability to reach large groups. However, in workplace health promotion participation levels are typically below 50%.[1] These low participation levels may have important consequences for the effectiveness of health promotion programmes and raise concerns about the generalizability of results. Therefore, information on participation and its determinants is needed. In addition to determinants of participation in health promotion programmes, there is also a need to assess whether participants obtain sufficient exposure to relevant programme content.[2]

The RE-AIM framework stresses the importance of evaluating the reach and representativeness of programme participants.[3] Several studies provide information on the reach of their programme, but information on the representativeness of programme participants or specifically the reach of individuals at-risk is scarce.[1] In addition to reach and determinants of initial participation, sustained participation is also of importance, because studies with higher programme utilization tend to have better outcomes concerning physical activity (PA) and dietary behaviour change,[4] and weight loss.[5] In our study a health promotion programme was offered in the workplace setting, combining face-to-face contact with an Internet-delivered programme. It has been found that frequent e-mail messages might enhance sustained participation in Internet-delivered programmes.[6-7] However, low initial participation levels (reach) and high levels of attrition are also common in Internet-delivered health promotion programmes.[4,8-9]

In previous research several factors that might influence participation in Internet-delivered behaviour change programmes were identified. It has been reported that women,[10-13] and individuals with a medium or high educational level[10-12] are more likely to start participating. For initial participation there is only scarce information on lifestyle- and health-related determinants, with one study showing that individuals with a normal body weight more often started to participate[13] and another study reporting that particularly individuals who needed it most were reached.[14]

Studies focusing on sustained participation reported that women[13,16] and older employees[10,12-17] were more likely to sustain participating in Internet-delivered behaviour change programmes. For lifestyle and health indicators the evidence is contradictory. It was found that participants with a healthy lifestyle at baseline, particularly non-smokers, more often sustained their participation.[10,15,18] However, there are also studies with higher sustained participation among overweight participants,[10] or among those not complying with healthy lifestyle guidelines.[13]

More studies are needed to investigate whether there is a consistent picture in whom we reach in health promotion and who keeps participating in primary preventive interventions. Therefore, we investigate in this study determinants of initial and sustained participation and the use of an Internet-delivered health promotion programme on physical activity and healthy nutrition in the workplace setting.

METHODS

Study design, participants and recruitment

Participants had enrolled in a 2-year cluster randomized controlled trial (cRCT), with departments (n=74) within companies (n=6) as the unit of randomization. An extensive description of the cRCT conducted between November 2007 and October 2010 is published elsewhere.[19] Participants were employees from health care organizations (n=2), commercial services (n=2), and the executive branch of government (n=2). Within the participating companies, the study was announced through e-mail, intranet, and/or a company magazine. Three companies restricted the maximum number of participants on a 'first in' principle. Participants enrolled voluntarily in the study by visiting the study website and completing the baseline questionnaire on lifestyle factors, health, and work demands. The study website also provided general information concerning lifestyle and health, as well as reports based on the online questionnaire. Subsequently, all participants could participate in a physical health check followed by a face-to-face contact discussing the health check and questionnaire results. One year after the baseline measurements, participants were asked to fill out the first follow-up questionnaire. Two years after baseline all participants were invited to fill out the second follow-up questionnaire, and to participate again in the physical health check. At baseline 987 participants filled out the questionnaire, of which 36 were excluded due to working less than 12 hours per week for the company, and an additional 27 were excluded because they did not fill out the questionnaire on physical activity and fruit and vegetable intake. In total, 924 employees met the inclusion criteria. During the first year after baseline, 860 non-participants received an abbreviated version of the questionnaire asking for the reason for not participating and questions on lifestyle, health, and work. A sample of non-participants in the health care organizations, and all non-participants in the two commercial services and in one executive branch of government received the questionnaire. In the other organization in the executive branch of government non-participants were not invited to fill out the questionnaire. Since the programme was initiated in the holiday period and communicated in a very limited way, and only 200 workers were allowed to participate, most workers in that organization were unaware of the programme. Due to privacy regulations the non-participants questionnaire was send out only once without any reminders. In total, 213 employees out of 860 non-participants responded (24.8%) of which 183 (85.9%) met the inclusion criteria, which were the same as for the participants. The Medical Ethics Committee of Erasmus MC, University Medical Center in Rotterdam, the Netherlands, approved the study and all participants gave written informed consent.

Intervention

Participants in the intervention condition had access to several additional Web-based tools compared to participants in the reference condition:

- more extensive computer-tailored advice on their self-reported PA and nutrition behaviour in the questionnaire. The electronically generated advice included personal and action feedback taking into account perceived barriers for participants not meeting the guidelines.[19-20]
- online self-monitors on fruit and vegetable intake, PA, and weight to monitor progress toward behaviour change and to obtain tracking charts,
- a food frequency questionnaire (FFQ) assessing saturated fat intake for tailored advice;[21]
- asking questions to several professionals;
- monthly e-mail messages during the first 12 months of the study. In all monthly e-mail messages, which focused on PA and nutrition, participants were encouraged to fill-out self-monitors and to submit their questions to the available professionals.

Outcomes

Initial and sustained participation

Initial participation was defined as filling out the baseline questionnaire to obtain advice on lifestyle. Sustained participation was defined as filling out the questionnaire after 12 or 24 months. The use of the Internet-delivered programme was measured as visiting the website throughout the study period. Two periods for programme use were distinguished: the first three months after the invitations to fill out the questionnaire, and the remaining period.

Determinants

Individual characteristics

In the baseline questionnaire, participants were asked about their age, sex, education, ethnicity, and marital status. Educational level was assessed by the highest level of education completed and was defined as low (primary school, lower and intermediate secondary school, or lower vocational training), intermediate (higher secondary school or intermediate vocational school) and high (higher vocational school or university). Two categories were created for ethnicity: Dutch and other, according to the standardized procedures described by Statistics Netherlands.[22]

Lifestyle and health indicators

PA was measured in the baseline questionnaire by the short version of the International Physical Activity Questionnaire (IPAQ), which assessed moderate and vigorous intensity PA.[23] The average time spent on PA per day was calculated. Walking was not included in this calculation, because casual walking is regarded a light-intensity activity.[24] For all behaviours, a dichotomous variable was calculated for non-compliance with the national recommenda-

tions. Fruit and vegetable intake (FV) was measured with the nine-item validated Dutch Food Frequency Questionnaire.[25] Smoking was defined as current smoking status, and excessive alcohol use as drinking 15 or more glasses of alcohol per week for women and 22 or more glasses for men. The first question of the Short Form-12 questionnaire was used to measure perceived general health, which was dichotomized into 'poor or moderate' and 'good to excellent'.[26]

In the physical health check, height and weight were measured to calculate the Body Mass Index (BMI) and to categorize individuals as normal weight (BMI<25 kg/m^2), overweight (25≤BMI<30 kg/m^2), and obese (BMI≥30 kg/m^2). For non-participants, weight was self-reported in the questionnaire. Total blood cholesterol was measured in non-fasting blood through a finger prick (Accutrend GC, Roche Company, Mannheim, Germany), and blood pressure was measured with a fully automated sphygmomanometer (Omron M4-I, Omron HealthCare Europe BV, Hoofddorp, the Netherlands). A total cholesterol level above 5.0 mmol/l and a systolic or diastolic blood pressure above respectively 140 mmHg and 90 mmHg were considered elevated. A sub-maximal exercise test on a bicycle ergometer was conducted to predict maximal oxygen uptake, according to the American College of Sports Medicine's protocol, using their sex- and age-dependent cut-off points.[27]

Social cognitive variables

For both PA and fruit and vegetable intake, attitude, social support, self-efficacy, and intention to change were measured in the baseline questionnaire. All variables were dichotomized. To measure attitude, individuals were asked to indicate on a 5-point Likert scale ('certainly not' to 'certainly') whether they thought improving the behaviour would take a lot of effort.[28] Those participants who answered 'probably or certainly not' were considered as having a positive attitude. Social support was measured by asking whether family and friends support them in changing the specific behaviours (4-point Likert scale ranging from 'seldom or never' to 'a lot').[29] High social support was defined as perceiving pretty much or a lot of support. Self-efficacy was assessed on a 5-point Likert scale ('certainly not' to 'certainly') by asking whether the participant was confident to engage in the healthy behaviours in the next month.[29] High self-efficacy was defined as probably or certainly confident to change the behaviour. Intention was also measured on a 5-point Likert scale ('certainly not' to 'certainly') by asking whether the participant intended to change the behaviour in the next month.[29] A high intention was defined as probably or certainly intended to change the behaviour.

Work-related factors

Physical work demands were measured by one item, asking whether participants perceive their current job as mainly physically or mentally demanding.

Statistical analyses

Descriptive statistics were used to present the baseline characteristics of the study population. For initial participation individual characteristics, behaviours, social cognitive variables, and health indicators of participants were compared with workers who did not start to participate in the programme. Determinants of initial participation were investigated with univariate logistic regression analyses.

For sustained participation individual characteristics, behaviours, and health indicators from participants who sustained their participation at 12 and 24 months follow-up were compared with employees who did not participate in these follow-up measurements. Determinants of sustained participation were also investigated with logistic regression analysis. First, univariate logistic regression models were carried out to determine the single effects of the possible determinants. All variables with a *p*-value less than 0.05 in any univariate model either at 12 or 24 months were included in both multivariate analyses to increase comparability. A backward selection method was used to determine the multivariate models, whereby age and sex were included by default. Variables with a *p*-value of 0.05 or less in either the 12 months or 24 months model were retained in the multivariate model. All analyses were adjusted for company and carried out with the PASW Statistics version 17.0.2 (SPSS Inc, Chicago, IL, USA).

For website use individual characteristics, behaviours, and health indicators from participants who visited the Internet-delivered programme were compared with non-visitors. Descriptive statistics were used to present the use of the different website functionalities, and multilevel General Estimating Equations (GEE) were used to study determinants of website visit. The same procedure was followed as for sustained participation. GEE is suitable for the analysis of repeated measurements within participants, and was carried out with SAS 9.2 statistical software package.

The results are presented by the odds ratios (OR) and corresponding 95% confidence intervals (95% CI), with ORs below and above 1 representing respectively lower and higher participation.

RESULTS

The baseline characteristics of the study group are presented in Table 8.1. Half of the participants (49%) were male workers. The mean age was 42 years, ranging from 20 to 63 years and 45% had a high education level. Almost a third of the participants (32%) were not physically active at moderate to vigorous intensity for at least 30 minutes per day, and 47% had insufficient fruit and vegetable intake.

Table 8.1 Differences between participants (n=924) and a sample of non-participants (n=183) in a workplace health promotion programme

	Participants (n=924)		Non-participants (n=183)		Initial participation univariate analyses	
	n	%	n	%	OR	95%CI
Demographics						
Male gender	450	49	62	34	1.17	0.81-1.70
Age (years)						
<30	128	14	43	24	1.00	.
30-39	253	27	46	25	1.57	0.96-2.57
40-49	277	30	39	22	2.25*	1.36-3.72
≥50	266	29	53	29	1.61	0.99-2.62
Education level						
High	414	45	102	56	1.00	.
Intermediate	306	33	49	27	1.15	0.78-1.70
Low	204	22	32	18	1.05	0.66-1.68
Non-Dutch ethnicity	151	16	29	16	1.04	0.66-1.63
Unmarried / not cohabiting	222	24	41	22	1.20	0.81-1.77
Lifestyle factors						
<30min/day moderate PA	297	32	58	32	1.01	0.71-1.44
<3x 20min/day vigorous PA	652	71	128	70	1.15	0.80-1.65
<400g/day fruit and vegetables	435	47	n/a	n/a	n/a	n/a
Current smoker	165	18	28	15	1.08	0.69-1.70
Excessive alcohol consumption	24	3	5	3	0.98	0.36-2.67
BMI[b] <25 kg/m^2	460	57	119	65	1.00	.
25≤BMI<30 kg/m^2	277	34	58	32	1.11	0.69-1.44
≥30 kg/m^2	70	9	6	3	2.24	0.93-5.42
Social cognitive factors						
Physical activity						
Poor attitude	464	50	87	47	1.24	0.89-1.72
Low support from family	772	84	166	90	0.63	0.37-1.08
Low self-efficacy	214	23	33	18	1.48	0.97-2.25
Low intention	478	52	121	66	0.60*	0.43-0.85
Fruit and vegetable intake						
Poor attitude	280	30	n/a	n/a	n/a	n/a
Low support family	784	85	n/a	n/a	n/a	n/a
Low self-efficacy	167	18	n/a	n/a	n/a	n/a
Low intention	180	20	n/a	n/a	n/a	n/a
Health indicators[1]						
Poor/moderate general health	58	6	15	8	0.83	0.45-1.52
Elevated blood pressure	258	32	n/a	n/a	n/a	n/a
Poor predicted Vo_2max	267	36	n/a	n/a	n/a	n/a
Elevated total cholesterol	338	42	n/a	n/a	n/a	n/a
Work-related factors						
Physical job demands	148	16	42	24	0.84	0.56-1.56
Health Check participation	811	88	n/a	n/a	n/a	n/a
Intervention group	456	49	n/a	n/a	n/a	n/a

* $p < 0.05$, analyses adjusted for company, PA physical activity, BMI body mass index, Vo_2max maximum oxygen uptake, n/a not available

[1] BMI, blood pressure, maximum oxygen uptake, and cholesterol level are only available for the participants in the physical health check (n=807)

Initial participation

Of the 183 non-participants responding to the questionnaire for non-participants, most gave 'I am healthy' (41%) as their reason for not participating in the programme, followed by 'other reasons' (34%), of which most are practical reasons such as a lack of time, forgotten to subscribe, or unaware of the existence of the programme, 13% of the non-participants would like to keep private life and work separated, and 19% of the non-participants (also) preferred to arrange participation themselves. Most participants (86%) mentioned 'curious about my health' as their most important reason to participate.

Employees aged 30 years and older were more likely to start participating in the programme (ORs between 1.57 and 2.25). Workers with a low intention to increase their physical activity level were less likely to participate (OR=0.60, 95% CI 0.43-0.85).

Sustained participation

After one year 666 out of 924 participants (72%) filled out the questionnaire, and 558 out of 924 (60%) filled out the two-year follow-up questionnaire to obtain feedback on their lifestyle. As shown in Table 8.2, older employees were more likely to sustain their participation at follow-up, while employees with a non-Dutch ethnicity were less likely to sustain their participation. In the univariate analyses married/cohabiting participants were more likely to keep participating, but after adjustment for age, lifestyle and health indicators the association diminished and did not remain statistically significant (OR_{1yr}=1.34, 95% CI 0.87-2.07; OR_{2yr}=0.94, 95% CI 0.63-1.40).

Smokers and participants with a poor predicted maximum oxygen uptake were less likely to sustain their participation. Insufficient fruit and vegetable intake was also associated with reduced participation in the follow-up measurements, but this association did not remain statistically significant after adjustment for the predicted maximum oxygen uptake (OR_{1yr}=0.87, 95% CI 0.60-1.26, OR_{2yr}=0.87, 95% CI 0.63-1.20). Participants in the intervention condition were less likely to participate again after one year compared with the control condition. This relation was not apparent in the analysis for participation at two-year follow-up.

Participants with a low intention to change their physical activity level (OR_{1yr}=1.69, 95% CI 1.26-2.27; OR_{2yr}=1.40, 95% CI 1.07-1.83) or fruit and vegetable intake (OR_{1yr}=2.06, 95% CI 1.45-2.92; OR_{2yr}=1.93, 95% CI 1.38-2.70) were more likely to sustain participating at one- and two-year follow-up. Workers with low social support (PA: OR=0.44, 95% CI 0.30-0.63, FV: OR=0.46, 95% CI 0.31-0.68) and low self-efficacy (PA: OR=0.16, 95% CI 0.11-0.23, FV: OR=0.38, 95% CI 0.22-0.66) were less likely to have the intention to change their behaviour (not in table).

Most employees participating in the 2nd follow-up questionnaire also participated in the 2nd physical health check (65%), and, except insufficient fruit and vegetable intake, similar determinants were found as for sustained questionnaire participation. Age ($OR_{40\text{-}49yr}$=1.99, 95% CI 1.19-3.33; OR_{50+yr}=1.74, 95% CI 1.01-2.9) and Dutch ethnicity (OR=1.59, 95% CI 1.02-2.44) were statistically significantly related with sustained health check participation. Employees with

Table 8.2 Determinants of sustained participation after 1 and 2 year in a workplace health promotion programme (n=924).

	1 year follow-up participation				2 year follow-up participation			
	univariate		multivariate		univariate		multivariate	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual characteristics								
Male gender	1.42*	1.03-1.97	1.04	0.70-1.55	1.41*	1.05-1.90	1.15	0.81-1.64
Age (years)								
<30	1.00	.	1.00	.	1.00	.	1.00	.
30-39	1.51	0.97-2.36	1.47	0.70-1.55	1.33	0.86-2.05	1.39	0.83-2.32
40-49	2.52*	1.59-4.00	2.36*	1.35-4.12	2.29*	1.48-3.54	2.08*	1.25-3.47
≥ 50	3.01*	1.86-4.86	2.38*	1.30-4.33	2.89*	1.84-4.55	2.47*	1.43-4.26
Education level								
High	1.00	.			1.00	.		
Intermediate	1.14	0.80-1.62			0.98	0.71-1.34		
Low	0.77	0.52-1.14			0.72	0.50-1.03		
Non-Dutch ethnicity	0.62*	0.42-0.89	0.77	0.48-1.22	0.47*	0.33-0.67	0.51*	0.34-0.78
Unmarried	0.61*	0.44-0.85			0.73*	0.53-0.99		
Lifestyle factors								
<30min/day moderate PA	0.75	0.56-1.02			0.83	0.63-1.11		
<3x 20min/day vigorous PA	1.03	0.74-1.42			1.14	0.85-1.53		
<400gr/day fruit & vegetables	0.65*	0.49-0.88			0.73*	0.56-0.96		
Current smoker	0.53*	0.37-0.75	0.52*	0.33-0.82	0.51*	0.36-0.72	0.54*	0.35-0.82
Excessive alcohol intake	1.29	0.50-3.33			0.93	0.41-2.13		
BMI <25 kg/m^2	1.00	.			1.00	.		
25≤BMI<30 kg/m^2	1.17	0.81-1.68			0.98	0.71-1.35		
≥30 kg/m^2	1.29	0.69-2.42			0.90	0.53-1.53		
Health indicators[1]								
Elevated blood pressure	1.22	0.85-1.76			0.95	0.69-1.31		
Poor predicted Vo_2max	0.54*	0.38-0.76	0.56*	0.39-0.81	0.66*	0.48-0.91	0.76	0.55-1.06
Elevated total cholesterol	1.07	0.77-1.49			1.35*	1.00-1.82		
Decreased general health	0.71	0.40-1.25			0.49*	0.28-0.84		
Work-related factors								
Physical job demands	0.71	0.48-1.05			0.75	0.52-1.09		
Intervention group	0.63*	0.47-0.85	0.56*	0.39-0.81	0.85	0.65-1.12	0.92	0.67-1.28

* $p < 0.05$, analyses adjusted for company

[1] BMI, blood pressure, maximum oxygen uptake, and cholesterol level are only available for the participants in the physical health check (n=807)

a low intention to change their behaviour were more likely to participate in the follow-up health check (PA: OR=1.28, 95% CI 0.97-1.70, FV: OR=1.47, 95% CI 1.01-2.15) (not in table).

Website use

Six per cent of the participants did not visit the website throughout the study period, 18% visited the website once, 13% twice, and 64% three times or more. The percentage of participants visiting the website more than once was highest in the first months of the study compared with subsequent periods. Table 8.3 shows that the percentage of participants visiting the website was highest in the periods after the baseline and follow-up measurements. In the period 4-12 months after baseline, participants in the intervention condition, who received monthly e-mail messages during this period, were more likely to visit the website (OR=5.88, 95% CI 3.75-9.20, adjusted for company).

As shown in Table 8.4, smokers were less likely to visit the website throughout the two year follow-up period compared with non-smokers. Participants with a low intention to increase their fruit and vegetable intake (1-3 months: OR=1.73, 95% CI 1.31-2.27; 4-12 months: OR=1.47, 95% CI 0.92-2.36) were more likely to visit the website (not in table).

Table 8.3 Website visit and use of different website functionalities throughout the study in the control (C) and intervention (I) programme

Month	Study population		Website visit		Viewed advice physical activity		Viewed advice fruit and vegetables		Self-monitor	fat FFQ	Asked question
	C	I	C	I	C	I	C	I	I only	I only	I only
	n	n	%	%	%	%	%	%	%	%	%
1-3[1]	386	412	74	71	30	27	30	25	7	n/a	0
4-12	468	456	6	27*	2	3	2	3	6	15	3
13-15[2]	385	344	76*	66	23	18	26*	17	1	n/a	1
16-24[2]	385	344	2	3	1	0	1	0	0	n/a	0
25-28[3]	294	264	89	85	18*	11	19*	10	2	n/a	1

*Chi-square, $p < 0.05$

[1] for one company (executive branch of government) no information was available for website use in the first three months of the study.

[2] participants not responding to the first and second follow-up questionnaire were considered as drop-outs and not included in the analysis for 13-24 months.

[3] participants not responding to the second follow-up questionnaire were considered as drop-outs and not included in the analysis for 25-28 months.

Table 8.4 Determinants of website use of a workplace health promotion programme

	Website use month 1-3 after invitations to fill out questionnaire (n=630)[2]				**Website use month 4-12 after invitations to fill out questionnaire (n=729)**			
	univariate		multivariate		univariate		multivariate	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual characteristics								
Male gender	0.88	0.71-1.11	0.87	0.69-1.09	1.09	0.78-1.52	1.01	0.72-1.43
Age (years)								
21-29	1.00	.	1.00	.	1.00	.	1.00	.
30-39	1.05	0.74-1.51	1.06	0.74-1.52	0.90	0.50-1.61	0.85	0.47-2.20
40-49	1.31	0.92-1.88	1.32	0.92-1.89	1.15	0.66-2.00	1.12	0.64-1.98
≥ 50	1.14	0.80-1.63	1.18	0.82-1.70	1.25	0.72-2.18	1.24	0.70-1.52
Education level								
High	1.00	.			1.00	.		
Intermediate	0.86	0.67-1.11			0.96	0.66-1.40		
Low	0.73*	0.54-0.97			0.83	0.53-1.30		
Non-Dutch ethnicity	0.96	0.70-1.31			0.82	0.51-1.33		
Unmarried	1.06	0.81-1.38			0.86	0.58-1.29		
Lifestyle factors								
<30min/day moderate PA	1.03	0.81-1.31			1.04	0.73-1.48		
<3x 20min/day vigorous PA	1.11	0.87-1.41			0.83	0.58-1.18		
<400gr/day fruit & vegetables	0.86	0.69-1.07			0.83	0.59-1.16		
Current smoker	0.71*	0.53-0.95	0.72*	0.54-0.96	0.64	0.39-1.04	0.66	0.40-1.08
Excessive alcohol intake	1.01	0.50-2.05			0.87	0.29-2.59		
BMI[b] <25 kg/m^2	1.00	.			1.00	.		
25≤BMI <30 kg/m^2	1.08	0.84-1.40			1.03	0.56-1.91		
≥30 kg/m^2	1.19	0.76-1.86			0.96	0.52-1.77		
Health indicators[1]								
Elevated blood pressure	1.13	0.87-1.46			1.13	0.79-1.61		
Poor predicted Vo_2max	0.75	0.53-1.08			0.99	0.59-1.65		
Elevated total cholesterol	1.04	0.81-1.32			0.84	0.59-1.18		
Decreased general health	0.83	0.51-1.34			0.97	0.48-1.96		
Work-related factors								
Physical job demands	1.00	0.73-1.36	0.99	0.71-1.36	0.57*	0.33-0.97	0.59	0.34-1.02

* $p < 0.05$, analyses adjusted for company

[1] BMI, blood pressure, maximum oxygen uptake, and cholesterol level are only available for the participants in the physical health check (n=807)

[2] for one company (executive branch of government) no information was available for website use in the first three months of the study.

DISCUSSION

Modest initial participation and a high attrition in a health promotion programme were found. Employees aged 30 years and older were more likely to start participating in the programme as well as to sustain their participation. Lifestyle and health indicators were not related with initial participation, but did play a role in sustained participation as well as in visiting the website throughout the study period. Workers with a low intention to change their physical activity level were less likely to start to participate, but once participating they were more likely to sustain and to use the website.

Participation

Previous studies reported low participation and high levels of attrition in Internet-delivered health promotion programmes.[4,8-10] In a systematic review a median reach of 33% (95% CI 25–42%) was found in workplace health promotion programmes.[1] In our study three companies restricted the maximum number of employees allowed to enrol, leading to an artificially lower participation level. Without these companies, a mean initial participation level of 43% was established. Once participating, 72% also participated in the 1st follow-up, and 60% in the 2nd follow-up measurement. This is in agreement with a systematic review reporting that the majority of Internet-delivered weight loss programmes had less than 80% retention.[5]

Determinants of participation

In a systematic review studying initial participation in workplace health promotion, no major differences in lifestyle and health indicators were identified.[1] With our focus on workers, a relatively healthy group is reached, since workers are in better health than unemployed individuals.[30] In general, the employees who participated in our study had a quite similar lifestyle and health as employees responding to the non-participants questionnaire. Although non-significant, obese workers were more likely to enrol in the study. This is in accordance with other recent studies reporting that obese individuals were more likely to participate in Internet-delivered programmes, arguing that this might be due to the non-stigmatizing way of addressing body weight through the Internet.[10,14]

In line with other studies,[10,12-17] we found that older employees started more often and sustained their participation during the follow-up measurements. A recent study investigating a workplace health promotion programme, also reported increased participation among older workers,[31] which is a promising finding regarding the higher risk on cardiovascular diseases at older age, and employers' focus on keeping the ageing workforce healthy. However, older employees did not use the website more often compared with younger workers.

It is remarkable that employees with a low intention to change their behaviour were less likely to participate in the study, but once participating, those with a low intention were more likely to sustain at follow-up, and to visit the website throughout the study period. This might

indicate that the programme is appealing for employees with a low intention to change their behaviour. Alternatively, it might also indicate that those participants who intent to change their behaviour do not need the programme to get into action. To our knowledge only one study provided information on the role of intention to change in participation.[12] They did report that workers with a positive health motivation were more likely to continue website use, but did not find a correlation between intention to increase physical activity and participation. Measuring intention to change in other studies could provide more insight in the role of intention in participation, and might help to find out what programme content facilitates reach and sustained participation for those with a low intention to change.

Previous studies have presented contradictory results concerning the relation between lifestyle and health indicators and sustained participation, with some studies[10,13] describing elevated participation among those who need it most and other among those who are already healthy or engage in a healthy lifestyle.[10,15,18] We found a consistent lower sustained participation among smokers and employees with a low cardio-respiratory fitness. The relation between insufficient fruit and vegetable intake and decreased participation did not remain statistically significant after adjustment for health indicators. However, these associations between an unhealthy lifestyle behaviours and decreased participation are concerning, and might reduce the effectiveness of primary preventive interventions.

Website functionalities

Previous studies reported high attrition in Internet-delivered health promotion programmes.[8,10] We also found a reduction in website visitors throughout the study period, with peaks in the months after the invitations to fill out the questionnaires. Between the questionnaire invitations, the participating companies did not communicate about the programme towards the workers. Therefore, the embedding of the programme in the organizations was limited.

Participants in the intervention group received monthly e-mail messages during the first study year, and 27% visited the website compared with 6% in the control group during this period. These monthly e-mail messages seem to work as a prompt for website visit, but might have had a negative influence on sustained participation, with a lower percentage of participants in the intervention group filling out the first follow-up questionnaire. In the second year after baseline no monthly e-mail messages were sent, and at the end of the second year there was no statistically significant difference between the control and intervention condition in both follow-up participation and website visit. A possible explanation for the lower participation among intervention participants at the first follow-up could be that they feel less need to fill out the questionnaire to obtain feedback, because they already received information in the monthly messages and self-monitors throughout the year. An alternative explanation could be that the e-mails lead to resistance of participants towards the study. In a systematic review it was concluded that the use of periodic prompts can be effective

in behaviour change interventions.[32] However, the optimal frequency and structure of such prompts is unknown.

In accordance with previous studies,[33] users appear not to be optimally utilizing key aspects of the intervention. Only a minority of the employees who filled out the questionnaires also read the subsequent advice on PA and fruit and vegetable intake, and the number of participants using self-monitors on a regular basis and asking questions to professionals was limited. This is in contrast with the wishes of potential users as identified in focus group interviews.[34] It could be questioned if self-monitoring and the possibility of asking questions fit with the wishes of our target group. In addition, there are numerous websites freely available with self-monitor functions and possibilities to obtain personal feedback on lifestyle and health, what might reduce the employees' need of another website. Since participants could use the website on their own discretion, the programme is less structured. This might have led to lower use, making this minimal effort intervention not enough to elicit programme compliance.

Limitations

This study has some limitations. First, the 25% response to the questionnaire for non-participants was low, and might induce selection bias. Second, the measures for website use do not provide any information as to what extent the participants actually read the available information or how much time they spent on the website. In addition, reasons for drop-out are unknown. Therefore, we do not know whether individuals stop participating because they do not need the programme anymore, because they are dissatisfied with the programme, or because of another reason. Furthermore, because of technical problems no data on website use were collected for 99 participants during the first three study months. Last, the reason for website visit is unknown. To correct for website visit solely to fill out questionnaires, one login was subtracted in the periods following an invitation to fill out the questionnaires.

Conclusion

Modest initial participation and high attrition in programme use were found. Workers with a low intention to increase their physical activity level were less likely to start to participate, but once participating they were more likely to sustain their participating. Lifestyle and health indicators were not related with initial participation, but those with an unhealthier lifestyle were less likely to sustain their participation. This might influence programme effectiveness. Regular e-mail messages prompted website use, but the use of important intervention characteristics was limited. There is a need for more appealing techniques to enhance retention and to keep those individuals who need it most attracted to the programme.

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9

Cost-effectiveness of a long-term Internet-delivered worksite health promotion program on physical activity and nutrition: a cluster randomized controlled trial

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Submitted

ABSTRACT

This study aims to evaluate the cost-effectiveness of a long-term workplace health promotion programme on physical activity and nutrition. In total, 924 participants enrolled in a two-year cluster randomized controlled trial, with departments (n=74) within companies (n=6) as the unit of randomization. The intervention was compared with a standard programme consisting of a physical health check with face-to-face advice and personal feedback on a website. The intervention consisted of several additional website functionalities: action-oriented feedback, self-monitoring, possibility to ask questions, and monthly e-mail messages. Primary outcomes were meeting the guidelines for physical activity, and fruit and vegetable intake. Secondary outcomes were self-perceived health, obesity, elevated blood pressure, elevated cholesterol level, and maximum oxygen uptake. Direct and indirect costs were calculated, and a process evaluation was performed. Of the 924 participants, 72% participated in the first and 60% in the second follow-up. No statistically significant differences were found on primary and secondary outcomes, or on direct or indirect costs. Average direct costs per participant over the two-year period were €376, and average indirect costs were €9,476. In conclusion, no additional benefits were found in effects or cost savings. Therefore, the programme in its current form cannot be recommended for implementation.

INTRODUCTION

Insufficient physical activity (PA) and poor nutrition are important determinants of the burden of disease in most western countries.[1] Therefore, a whole range of health promotion programmes is offered. There are indications that Internet-delivered interventions may be effective in improving physical activity, healthy nutrition and weight reduction.[2-6] However, low participation and high levels of attrition are often observed in Internet-delivered programmes.[6-9] Therefore, different settings and methods to provide Internet-delivered programmes should be considered. The workplace might be a promising setting for health promotion with the ability to reach large numbers of people in a natural social environment.[10-11]

Systematic reviews have reported null to modest effects of workplace health promotion programmes (WHPPs) on physical activity, healthy diet, and measures of overweight.[12-17] Effect sizes were often low, e.g. less than 0.5 kg/m^2 decrease in BMI,[17-18] and the quality of the underlying studies is often limited, e.g. lacking a control group. In the literature several risks for ineffective health promotion programmes have been identified: a low selective participation, lack of adherence to the programme, and an intervention period too short for sustainable behaviour change.[10,12,19-20]

In the current study, we attempted to counteract these risks by combining a physical health check with face-to-face advice and tailored health promotion via the Internet. In a recent systematic review it was concluded that there is strong evidence of effectiveness of the assessment of health risks with feedback when used with additional health education activities.[21] Standard workplace health promotion programmes consisting of health risk assessment lacking additional health education activities have been found to be less effective. In addition to a physical health check, the intervention consisted of computer-tailored advice on physical activity and nutrition and access to a behaviour change monitoring functionality to get insight in the progress over time on health-related behaviours. Systematic reviews have shown small but significant short-term effects of computer-tailored education on health-related behaviour.[2,22] Previous research also showed that, amongst others, e-mail contact with participants is related to better exposure to Internet-delivered interventions.[23] To promote adherence to the programme and sustainability in behaviour change participants received continuous feedback and support through monthly e-mails. To determine the sustainable impact of interventions, studies with longer intervention and evaluation periods are needed.[20] Therefore, a long-term intervention was studied in a two-year evaluation period.

The aim of the present study is to evaluate the cost-effectiveness of a two-year Internet-delivered workplace health promotion programme on physical activity and nutrition.

METHODS

Participants enrolled in a 2-year cluster randomized controlled trial (cRCT), with departments (n=74) within companies (n=6) as the unit of randomization. The health promotion programme and evaluation are targeted at the individual level. An extensive description of the design of the cRCT is published elsewhere.[24] The Medical Ethics Committee of Erasmus MC, University Medical Center in Rotterdam, the Netherlands, approved the study and all participants gave written informed consent.

Study population and randomization

Participants were employees from health care organizations (n=2), commercial services (n=2), and an executive branch of government (n=2). Eligibility criteria for individual workers in the study were: 1) paid employment, 2) working at least 12 hours a week, and 3) being literate enough to read and understand simple e-mail and Internet-based messages in the Dutch language. There were no eligibility criteria at cluster level. Within each company, units were randomized by a researcher, who was not involved in collecting the data, based on a table of random numbers. All participants from one worksite were randomized together rather than individually to avoid contamination. Since it was deemed not possible within companies to withheld participation in a WHPP, workers within the control condition received a standard WHPP. Participants were blinded to group assignment.

Procedure and intervention

Within the participating companies, the study was announced through e-mail, intranet, or a company magazine. Three companies restricted the maximum number of participants on a 'first in' principle. All participants enrolled voluntarily in the study by visiting the study website and completing the baseline questionnaire on lifestyle factors, health, and work demands. Baseline measurements took place between November 2007 and October 2008. The study website also provided general information concerning lifestyle and health, as well as personal reports based on the online questionnaire. Subsequently, all participants could participate in a physical health check followed by a face-to-face contact in which the health check and questionnaire results are discussed. One year after the baseline measurements, participants were asked to fill out the first follow-up questionnaire. Two years after the baseline measurements, all participants were invited to fill out the second follow-up questionnaire and to participate again in the physical health check.

Figure 9.1 shows the participant flow through the phases of the trial. Complete baseline questionnaire data were available for 924 employees, and health check data were available for 810 employees.

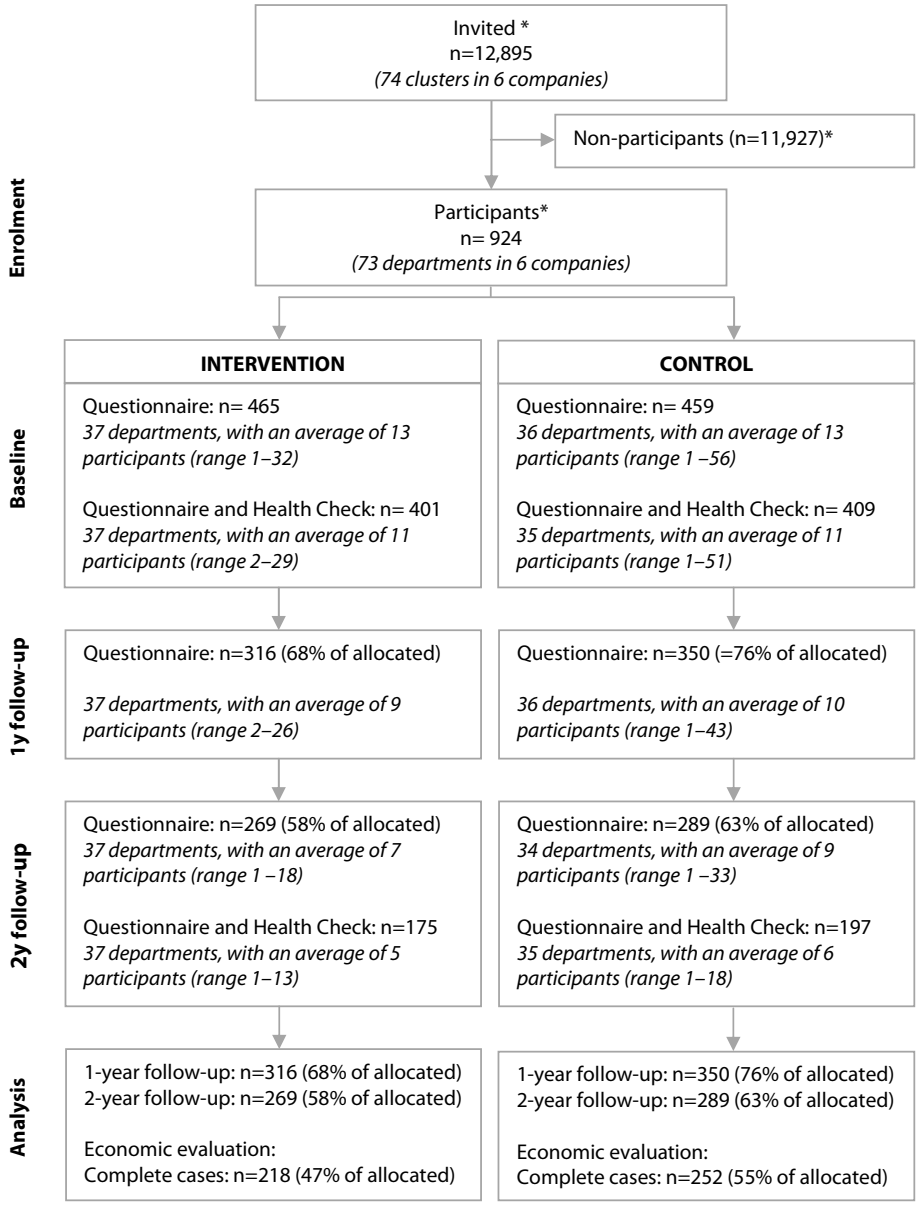

Figure 9.1 Flow diagram of the progress through the phases of the study

Intervention

Participants in the intervention condition had access to several additional website functionalities compared to participants in the reference condition:

- Extensive computer-tailored advice on their self-reported PA and fruit and vegetable intake. The electronically generated advice included personal and action feedback, taking into account perceived barriers for participants not meeting the guidelines.[24-25]
- Online self-monitors on fruit and vegetable intake, PA, and weight in order to monitor progress toward behaviour change and to obtain tracking charts;
- A food frequency questionnaire (FFQ) assessing saturated fat intake for tailored advice;[26]
- Possibility to submit particular questions to several health professionals.

In addition, participants in the intervention group received monthly e-mail messages during the first 12 months of the study. In all monthly e-mail messages, which focused on PA and nutrition, participants were encouraged to fill-out self-monitors and to submit their questions to the available professional.

Measurements

Primary outcomes

The primary outcomes of the study were physical activity level and fruit and vegetable intake.

PA was measured by the short version of the International Physical Activity Questionnaire (IPAQ), which assessed moderate and vigorous intensity PA.[27] The average time spent on PA per day was calculated. Walking was not included in this calculation, since casual walking is regarded a light-intensity activity.[28] For sufficient moderate to vigorous PA a cut-off point of 30 minutes or more PA per day was used, and for sufficient vigorous PA a cut-off point of at least three times per week vigorous PA for at least 20 minutes on these days.[29] For sufficient fruit and vegetable intake the cut-off point was at least 200 grams for both fruit and vegetables. Fruit and vegetable intake were measured with the nine-item validated Dutch Food Frequency Questionnaire.[30]

Health indicators

Participants were asked to rate their own general health on a five point scale, ranging from 'excellent' 'very good', 'good' and 'moderate' to 'poor'.[31] This self-perceived health was dichotomized into 'poor or moderate' and 'good to excellent'.

In the physical health check, at baseline and two-year follow-up, height and weight were measured to calculate the Body Mass Index (BMI) and to categorize individuals as normal weight (BMI<25 kg/m^2), overweight (25≤BMI<30 kg/m^2), and obese (BMI ≥30 kg/m^2). In the first follow-up measurements height and weight were only self-reported. Total blood cholesterol was measured in non-fasting blood through a finger prick (Accutrend GC, Roche Company, Mannheim, Germany), and blood pressure with a fully automated sphygmomanometer (Omron M4-I, Omron HealthCare Europe BV, Hoofddorp, the Netherlands). A total cholesterol

level above 5.0 mmol/l and a systolic or diastolic blood pressure above respectively 140 mmHg and 90 mmHg were considered elevated. A sub-maximal exercise test on a bicycle ergometer was conducted to predict maximal oxygen uptake, according to the American College of Sports Medicine's (ACSM) protocol, and using their sex- and age-dependent cut-off points.[32]

Social cognitive variables

For both PA and fruit and vegetable intake, self-efficacy, intention to change, and perceived barriers were measured in the baseline questionnaire. Self-efficacy and intention to change were measured on a 5-point Likert scale ranging from 'certainly not' to 'certainly'. Self-efficacy was assessed by asking whether the participant was confident to engage in the healthy behaviours in the next month. High self-efficacy was defined as probably or certainly confident to change the behaviour. Intention was measured by asking whether the participant intended to change the behaviour in the next month.[33] A high intention was defined as probably or certainly intended to change the behaviour. Perceived barriers concerning PA and fruit and vegetable intake were assessed by asking for the most important barrier to engage in these behaviours. The question on barriers to engage in PA has the following answer categories: not enough time/too busy, do not enjoy sports, too expensive, tired, fear of injury, no facilities at home, no facilities in direct environment, lack of a partner to exercise with, health problems, unsafe environment, and no barriers. The question on barriers concerning fruit and vegetable intake has the following categories: not enough time/too busy, not tasty, too expensive, no facilities at work to buy fruit and/or vegetables, no availability in the shops in the home environment, and no barriers.[24]

Demographics

The demographic variables of importance are sex, age, marital status, ethnicity, and educational level. Educational level was assessed by asking the highest level of education completed and was defined as low (primary school, lower and intermediate secondary schooling, or lower vocational training), intermediate (higher secondary schooling or intermediate vocational schooling) and high (higher vocational schooling or university). Two categories were created for ethnicity, Dutch and other, according to the standardized procedures described by Statistics Netherlands.[34]

Economic evaluation

The economic evaluation was performed from a societal perspective. The following direct costs were determined: cost price of the standard WHPP, costs of the intervention and direct healthcare costs (Table 9.1). Direct healthcare costs were calculated by multiplying the volumes of health care use (existing of a variety of health professionals) with the corresponding unit prices. For the unit prices a remuneration fee was used, as supported by the Dutch guidelines (Table 9.1).[35]

Indirect costs consisted of costs due to productivity loss. The friction cost method was applied to calculate productivity loss, taking into account the degree of scarcity of labour in the economy.[36] In addition, in the Netherlands an elasticity of 0.8 is assumed for annual labour time versus labour time productivity, i.e. with a time loss of 10% the productivity would decrease with 8%.[36] Productivity loss is based on absenteeism and on productivity loss at work. Absenteeism due to health problems was measured with the Work Ability Index,[37] by asking to indicate on a 5-point ordinal scale on how many days in the past 12 months they were not able to work due to health problems. Productivity loss at work was measured using the quantity scale of the Quantity and Quality (QQ) method.[38] Respondents were asked to indicate how much work they actually performed during regular hours on their most recent regular workday as compared with normal. The time lost due to productivity loss at work was measured on a scale from 0 (nothing) to 10 (regular quantity). If a participant reported '0' on the quantity of productivity due to health problems, only absenteeism costs were considered

The direct healthcare costs and the indirect costs due to productivity loss were measured annually over the follow-up period of 24 months.

Table 9.1 Unit costs used in the economic evaluation

		Costs (€)
Programme costs	Health check (per participant)	150
	Project costs (per participant, e.g. support, meetings)	46
	Basic health portal (per participant)	10
	Intervention costs: self-monitoring, and contact with professionals (per participant per year)	5
	Intervention costs: monthly e-mail messages (per participant per year)	2
Direct health care costs	General practitioner (per contact)[a]	28
	Occupational physician (per contact)[b]	52
	Medical specialist (per out-patient visit)[a]	64
	Physical therapist (per contact)[a]	36
Indirect costs	Absenteeism paid work (per full day)[c]	240
	Productivity loss at work (per full day) [c]	240

€1.00 = $0.84, $1.36, price level april 2009

[a] advised price according to the Dutch guidelines,[35]

[b] advised price adjusted for price index,[39]

[c] costs based on employer's costs for the average wage per day in the Netherlands.[35]

Process evaluation

In the process evaluation participants were asked to evaluate the programme, to indicate whether they changed their lifestyle due to the advice at the health check or due to information and advice on the website. Participants in the intervention group were asked whether they received and read the monthly e-mail messages. Furthermore, their opinion on the frequency of the monthly e-mail messages was asked, and if they thought the messages were useful, promoted website visit and if the messages promoted a healthy lifestyle.

Statistical analyses

In the sample size calculation an intra-cluster correlation of 0.05 was used, with an average of 20 workers per cluster, an initial participation of 70% and loss to follow-up of 30%. Under these assumptions, it was anticipated to detect a difference of 12% in prevalence between the intervention and control group (power of 80%, significance level 0.05) with 350 workers with completed questionnaires assigned to the intervention.

The baseline characteristics of participants in the control and intervention group were compared with a chi-square test. The intra-cluster correlation coefficient (ICC) was calculated for the primary outcomes to express the proportion of the within-cluster variance in the total variance among subjects.

The effects of the intervention on primary and secondary outcome measures at 12 and 24 months were analysed with multi-level logistic regression analyses, taking into account the clusters, and were all adjusted for sex, age, and baseline. All analyses were carried out with the statistical package SAS version 9.2.

In the economic evaluation the various costs measures had very skewed distributions and the two-sided Mann-Whitney U-test was used to test for a significant difference.

RESULTS

Figure 9.1 shows that 924 employees responded to the invitation and filled out the baseline questionnaire and met the inclusion criteria for participation in the study. The response was 666 (72%) at 12 months follow-up, and 558 (60%) at 24 months follow-up. Loss to follow-up was statistically significantly associated with insufficient fruit intake, and with a poor predicted maximum oxygen uptake. Participants in the intervention were more likely to be lost to the first follow-up. At baseline the mean cluster size was 12.7 (range 1-56). The intra-cluster correlation varied between 0.01 (vegetable intake) and 0.10 (physical activity).

Table 9.2 presents the baseline characteristics of the participants in the intervention and reference group. Half of the participants (49%) were male workers. The mean age was 42 years, ranging from 20 to 63 years and 45% had a high education level. More than two-third of the participants (68%) met the recommendation for daily moderate to vigorous physical activity, and 29% engaged at least three times per week in vigorous physical activity. More than half of the participants (54%) ate at least 200 grams of fruit per day, and 45% had a daily intake of at least 200 grams of vegetables. The randomization was not completely successful in creating comparable groups. There was a difference for fruit intake at baseline, with more participants in the intervention meeting the guideline (χ^2=4.12, $p<0.05$).

Table 9.2 Baseline characteristics of the study population in a workplace health promotion program (n=924)

	Intervention (n=465)		Reference (n=459)	
	n	%	n	%
Female gender	249	54	225	49
Age				
<30 y	73	16	55	12
30-50 y	248	53	282	61
50+ y	144	31	122	27
Educational level				
Lower	89	19	115	25
Intermediate	153	33	153	33
Higher	223	48	191	42
Unmarried/ not cohabited	106	23	116	25
Non-Dutch ethnicity	77	17	74	16
Lifestyle				
Insufficient moderate to vigorous PA	313	67	314	68
Insufficient vigorous PA	143	31	129	28
Insufficient fruit intake	265	57[a]	231	50
Insufficient vegetable intake	211	45	201	44
Social cognitive variables				
High self-efficacy PA	353	76	357	78
High self-efficacy fruit & vegetable intake	388	83	369	80
No barriers PA	106	23	112	24
No barriers fruit & vegetable intake	376	81	348	76
Health indicators				
Good/excellent perceived health	440	95	426	93
Obesity*	36	9	36	9
Elevated blood pressure*	126	31	132	33
Elevated cholesterol level*	196	48	173	44
Poor or moderate Vo_2max*	137	35	159	42

* 810 respondents participated in the physical health check, [a] Chi-square, $p<0.05$

Effects of the intervention

Table 9.3 shows information on the estimated effects of the intervention on primary and secondary outcomes. There was no consistent effect of the intervention on these outcomes. In analyses using continuous variables for these outcomes similar findings were found. There were also no statistically significant intervention effects on social cognitive variables.

Changes over time

In the total group there were changes in primary outcomes over time. There were improvements in vigorous physical activity (OR=1.47, 95% CI 1.10-1.97) and vegetable intake (OR=1.36, 95% CI 1.01-1.83) one year after baseline. The improvement in vegetable intake (OR=1.43, 95% CI 1.05-1.97) remained after two year but the change in vigorous physical activity did not remain statistically significant (OR=1.22, 95% CI 0.89-1.67). Sufficient moderate

Table 9.3 Outcome measures at 12 and 24 months follow-up in the intervention and reference condition and the estimated effect of the intervention

	Intervention		Reference		Estimated effect
	n	%	n	%	OR (95% CI)
Primary outcomes					
Insufficient moderate to vigorous PA					
baseline (n=924)	313/465	67	314/459	68	.
12 months (n=649)	224/306	73	247/343	72	1.07 (0.73-1.55)
24 months (n=545)	189/260	73	207/285	73	1.01 (0.67-1.52)
Insufficient vigorous PA					
baseline (n=924)	143/465	31	129/459	28	.
12 months (n=654)	108/310	35	116/344	34	1.04 (0.72-1.52)
24 months (n=545)	70/260	27	100/285	35	0.67 (0.44-1.03)
Insufficient fruit intake					
baseline (n=924)	265/465	57	231/459	50	.
12 months (n=645)	188/305	62	188/340	55	1.18 (0.82-1.72)
24 months (n=541)	159/256	62	156/285	55	1.22 (0.79-1.87)
Insufficient vegetable intake					
baseline (n=924)	211/465	45	201/459	44	.
12 months (n=650)	148/307	48	168/343	49	0.96 (0.68-1.37)
24 months (n=541)	122/256	48	145/285	51	0.75 (0.51-1.12)
Secondary outcomes					
Less than good general health					
baseline (n=924)	25/465	5	33/459	7	.
12 months (n=650)	16/309	5	24/341	7	0.65 (0.30-1.40)
24 months (n=538)	18/255	7	17/283	6	1.30 (0.60-2.82)
Obesity					
baseline (n=810)	36/409	9	36/401	9	.
12 months (n=650)	24/309	8	32/341	9	1.56 (0.51-4.79)
24 months (n=538)	23/253	9	26/285	9	1.57 (0.52-4.76)
Elevated blood pressure					
baseline (n=812)	126/410	31	132/402	33	.
24 months (n=372)	43/175	25	57/197	29	0.82 (0.46-1.46)
Elevated cholesterol level					
baseline (n=807)	196/409	48	173/398	44	.
24 months (n=370)	106/175	61	107/195	55	1.30 (0.79-2.14)
Poor or moderate Vo_2max					
baseline (n=768)	137/390	35	159/378	42	.
24 months (n=358)	59/171	35	70/187	37	1.06 (0.60-1.88)

All multilevel logistic regression analyses were adjusted for age, sex and baseline. Odds ratios indicate comparison with the reference group.

to vigorous physical activity (1y: OR=1.32, 95% CI 0.99-1.82; 2y: OR=1.34, 95% CI 0.99-1.76) and fruit intake (1y: OR=1.29, 95% CI 0.94-1.77; 2y: OR=1.38, 95% CI 0.98-1.92) did not change statistically significant after one or two year.

Subgroup analyses

There was no intervention effect for subjects with insufficient moderate to vigorous physical activity (OR_{1yr}=1.30, 95% CI 0.73-2.33, OR_{2yr}=1.59, 95% CI 0.80-3.16), insufficient vigorous physical activity (OR_{1yr}=0.89, 95% CI 0.57-1.40, OR_{2yr}=0.63, 95% CI 0.38-1.06), or for those with insufficient vegetable intake at baseline (OR_{1yr}=1.25, 95% CI 0.78-2.00, OR_{2yr}=0.80, 95% CI 0.46-1.41). Participants in the intervention condition not meeting the guideline for fruit intake at baseline were more likely to meet the recommendation at 1-year follow-up compared with participants in the control condition (OR=2.03, 95% CI 1.20-3.44). This difference did not remain statistically significant at two-year follow-up (OR=1.14, 95% CI 0.65-1.98). There were no differences in intervention effects concerning low or intermediate/high educational levels.

Direct and direct costs

Table 9.4 presents the direct and indirect costs in both study groups during the two-year study period. Total costs during the follow-up were not statistically significantly different between intervention and reference group (€9,480 versus €10,952). The mean direct healthcare costs over the 2-year period were €376 (IQR: €80 - €516), and the mean indirect costs were €9,476 (IQR: €1,200 - €13,860). The indirect costs were attributed to sick leave (25%) and productivity loss at work (75%).

Table 9.4 Cost parameters in euro per participant in the year before the intervention, and in the first and second year of the intervention of participants with complete follow-up data (n=470)

	Baseline		**Year 1**		**Year 2**	
	I n=218	C n=252	I n=218	C n=252	I n=218	C n=252
Program costs						
Physical health check (€/person)	n/a	n/a	150	150	150	150
Website costs (€/person)	n/a	n/a	17	10	15	10
Project costs (€/person)	n/a	n/a	46	46	46	46
Mean program costs (€/person)	n/a	n/a	213	206	211	206
Direct healthcare costs						
General practitioner (prevalence)	66%	71%	66%	64%	70%	65%
Occupational physician (prevalence)	11%	5%	6%	7%	7%	8%
Medical specialist (prevalence)	39%	34%	38%	35%	40%	37%
Physical therapist (prevalence)	24%	29%	24%	29%	29%	26%
Mean direct costs (€/person)	190	187	167	191	186	204
Indirect costs						
Sickness absence (prevalence)	57%	57%	52%	49%	46%	48%
Productivity loss at work (prevalence)	34%	32%	33%	31%	31%	34%
Mean indirect costs (€/person)	4960	5149	4362	5497	4342	4647
Mean total costs (€/person)	5150	5336	4741	5895	4739	5057

n/a not applicable

Process evaluation

There were no statistically significant differences between participants in the control and intervention condition regarding their opinion on the overall programme with a median score of 8 out of 10 in both groups (intervention: M=7.4, SD=1.1; control: M=7.6, SD=1.0). Respectively 5% of the participants in the control condition, and 7% in the intervention condition indicated to be more physically active because of the advice on the website, and 8% of the control group compared with 5% in the intervention group indicated to eat healthier due to the website advice. A fifth of the participants (20%) in the intervention group reported that they did not receive any e-mails, and 22% answered maybe.

DISCUSSION

In this cluster RCT no additional intervention effects were found on physical activity and fruit and vegetable intake. The total direct and indirect costs in the intervention and control condition were comparable, but the programme costs were slightly higher for the intervention condition compared with the reference condition.

In a meta-analysis only small, non-significant effects were found on physical activity.[10] In addition, there is only low quality of evidence that workplace physical activity interventions significantly reduce body weight and BMI.[17] However, another systematic review reported strong evidence of workplace health promotion programmes on physical activity.[12] A systematic review studying the effectiveness of worksite physical activity and nutrition programmes also reported increased programme impact in more structured and intensive interventions.[18] In our study participants could visit the website on their own discretion, making it a less structured and intensive intervention.

A plausible explanation for the lack of an intervention effect is the non-use of the programme, and therewith a lack of contrast with the control condition. During the period in which the intervention group received monthly e-mail messages there was a higher programme utilization compared with the control condition.[40] However, still only a minority used the website. More than 40% of the participants in the intervention group reported that they did not received monthly e-mail messages or were uncertain if they did so, whereas they in fact had received these messages. Throughout subsequent periods, participants in the intervention condition did not visit the website more often compared with participants in the control condition. The use of self-monitors as well as the use of asking questions was limited. Because of the low use of several intervention components, there was a lack of contrast with the control condition, with both groups having a health check and general information on the website. Although there is an increasing popularity of Internet delivered programmes, the use of such programmes is often low.[7] Nowadays, there are more and more possibilities for

interaction between providers and participants using internet- and cell-phone-based interventions (e.g. [41]). A higher level of interaction might help to increase programme adherence.

In a systematic review the authors concluded that populations at-risk benefit most from behaviour change programmes in the workplace setting.[16] In our study a high percentage of participants already met the lifestyle recommendations at baseline. For the physical activity guideline this is likely due to over-reporting on the IPAQ. Over-reporting is a general concern in the measurement of self-reported physical activity.[42] With the majority already meeting the national guidelines, particularly for moderate to vigorous physical activity, there is only small room for improvement in the participating study population. However, when focusing on those participants not complying with the healthy lifestyle guidelines, there was only a modest positive intervention effect for fruit intake after one year.

Shain and Kramer (2004) have argued that health promotion programmes will only be effective in enhancing the health status of the workforce when the interventions attend to both individual and environmental influences.[43] This is in accordance with the findings in a recent systematic review showing greater improvements in workplace interventions with an environmental component.[17] In our study the intervention took place in the workplace setting, but the setting did not comprise a major role in the intervention programme, lacking environmental components. With the ability to make use of natural social networks, as well as shared environments there are opportunities to include more organizational aspects in behavioural interventions in the workplace setting.

Since the intervention did not show any effects, a cost-effectiveness analysis could not be conducted. The economic analysis showed that the costs of the intervention programme were modest and comparable to the direct costs. However, the economic evaluation will be driven by the indirect costs due to productivity loss (96%), which were much higher than direct costs (4%). A limitation in the economic evaluation was the measurement of indirect costs, with a categorical variable for sickness absence. Furthermore, possible compensation mechanisms were not taken into account, leading to an overestimation of indirect costs.

Limitations

Because companies from different branches participated in the study, there are no indications that the results are not generalizable to other workforce populations. However, there are other limitations in the study. As mentioned before, the measurement of sick leave is not optimal to make a cost evaluation. Another limitation in the study was that weight was measured at baseline and after 24 months, but self-reported at both follow-up measurements. Since at 24 months follow-up weight was self-reported and measured, these two types of measurement could be compared. Both measures were highly correlated ($r=0.99$, $p<0.001$).

Conclusion

The aim was to study whether a minimal effort intervention was effective in increasing physical activity and fruit and vegetable intake. No additional benefits were found in effects or cost savings. The programme in its current form can therefore not be recommended for implementation in companies.

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10 General discussion

INTRODUCTION

Numerous health promotion programmes aimed at healthy lifestyle behaviours are offered in the workplace setting. In this thesis, several studies are presented that focus on lifestyle and health among employees, and its associations with productivity losses. Research thus far mainly focused on the efficacy of behaviour change interventions, with less attention for issues as reach, participation, and their determinants. Insight in these issues is important, because the representativeness of the study participants and exposure to relevant programme content might provide information on why programmes are effective or not. As described in the introduction, the primary objectives of this thesis are:

1: To study the influence of unhealthy lifestyle, poor health, and strenuous working conditions on productivity loss at work and sick leave;
2: To identify determinants of reach and participation in workplace health promotion;
3: To study the cost-effectiveness of a long-term workplace health promotion programme containing a website component.

This chapter presents the main findings from this thesis. Furthermore, methodological issues will be discussed and new insights will be presented. Finally, implications of the study results for future research and practice will be discussed.

MAIN FINDINGS

Objective 1 To study the influence of unhealthy lifestyle, poor health, and strenuous work conditions on productivity loss at work and sick leave

The studies described in chapter 2 and chapter 3 showed that poor health is the most important contributor to the presence of productivity loss at work and sick leave, with odds ratios varying from 1.31 to 6.51. Smokers and obese workers were more days off work due to sick leave and were more likely to report productivity loss at work compared with non-smokers and workers with a normal body weight (chapter 2). Physical activity and fruit and vegetable intake did not play a major role in productivity loss at work or in sick leave (chapter 2, 3). More than 10% of sick leave and the higher levels of productivity loss at work may be attributed to unhealthy lifestyle factors and obesity (chapter 2). However, poor psychosocial working conditions were stronger associated with both productivity loss at work and sick leave than unhealthy lifestyle behaviours (chapter 3).

Productivity loss at work and sick leave were more apparent among employees with a low educational level, with an odds ratio of 1.56 for the more severe category of productivity loss at work and 1.90 for 10 or more days with sick leave. These differences could hardly be

assigned to differences in health. Work-related and lifestyle factors did attenuate the association between low education and sick leave (chapter 3).

In conclusion, poor health is an important risk factor of productivity loss at work and sick leave. Unhealthy lifestyle factors, particularly smoking and obesity, and strenuous work conditions, both physical and psychosocial, also play a role in productivity loss at work and sick leave.

Objective 2 To identify determinants of reach and participation in workplace health promotion

The systematic review (chapter 4), which included 23 studies on workplace health promotion programmes aimed at physical activity and a healthy diet, showed a large variation in participation levels, with a median participation of 33% (95% CI 25–42%). In general, female workers are more likely to start participating in workplace health promotion compared with male workers. Pooling of studies showed a higher participation level when the programme consisted of multiple components. With only few studies investigating the influence of lifestyle, health, and work-related factors on participation, insight in the underlying determinants of initial participation in workplace health promotion is hampered. Therefore, determinants of initial and sustained participation were investigated in a longitudinal study (chapter 8), in which employees of six companies could participate in a physical health check and make use of a personal website during a two-year period. The intervention was primarily aimed at increasing physical activity and fruit and vegetable intake (chapter 5). Older employees were more likely to start participating in the programme as well as to sustain. Lifestyle and health indicators were not related to initial participation, but did play a role in sustained participation as well as in visiting the website throughout the study period (chapter 8). Participants with an unhealthy lifestyle were less likely to sustain their participation and to use the programme website. In addition, workers with a low intention to change their physical activity level were less likely to start, but once participating they were more likely to sustain and to use the website (chapter 8). Female participants were more likely to use the website in the first months of the study to obtain personalized advice for behaviour change (chapter 7).

There was limited use of the specific intervention components, with only a minority of the participants who read their personalized advices, filled out self-monitors to track their behaviours, or asked questions. In contrast, individuals in the intervention group visited the website more often compared with participants in the control group during the first 12 months. In this period, the intervention group received monthly e-mail messages, which functioned as a prompt for website visit (chapter 7, 8).

Moral considerations regarding health promotion offered by employers were investigated (chapter 6). More than a fourth of the non-participants (26%), and 21% of the participants thought that employer interference with their health is a violation of privacy. There are, especially among older workers, concerns about the role of the employer in workplace health

promotion and the possible violation of privacy. However, most employees thought it is good that an employer tries to improve employees' health.

In conclusion, the reach in our study was in line with the median reach of 33% as found in a systematic review. We found that older employees were more likely to participate. Lifestyle and health were no determinants of initial participation, but participants with an unhealthy lifestyle were less likely to sustain and to use the website. In general, the use of specific programme elements was limited, with only a minority of the participants using the specific intervention components. However, monthly e-mail messages were a prompt to visit the website.

Objective 3 To study the cost-effectiveness of a long-term workplace health promotion programme containing a website component

In a cluster randomized controlled trial (cRCT) the effectiveness of a two-year health promotion programme was evaluated among employees (n=924) from six companies receiving a physical health check and personalized website. Participants in the intervention group had access to several additional website functionalities: a) more extensive computer-tailored advice including action-oriented feedback, b) possibility to use self-monitors to track their own behaviour and body weight throughout the two-year study period, c) opportunity to ask questions to several health professionals. In addition, they received monthly e-mail messages during the first 12 months (chapter 5). The cRCT showed no intervention effects on self-reported physical activity and fruit and vegetable intake (chapter 9). In addition, the programme had no beneficial effects on self-perceived health, body mass index, cholesterol level, blood pressure, and maximum oxygen uptake. Focusing on those participants not meeting the recommendations at baseline, a beneficial intervention effect was found for fruit intake at one year follow-up (OR 2.03).

The intervention costs were €7 per participant in the first 12 months and €5 in the subsequent 12 months higher compared with the standard programme. There were no differences in direct costs due to the use of health care resources or in indirect costs due to productivity loss at work and sick leave. The direct costs were lower than the indirect costs, with a mean of respectively €206 and €5139 per participant over the two-year period (chapter 9). We could not estimate which fraction of the costs could be attributed to lifestyle.

In conclusion, the long-term minimal effort intervention showed overall no additional benefits in effects or costs. The programme in its current form is therefore not recommended for implementation.

METHODOLOGICAL LIMITATIONS

Influence of an unhealthy lifestyle, poor health, and strenuous work conditions on productivity loss at work and sick leave

In chapter 2 and 3, associations between lifestyle, health, and work-related factors with productivity loss at work and sick leave were investigated.

Study design

The study in chapter 2 had a cross-sectional study design, which does not permit further explanation with respect to causality. However, our findings were in line with previous longitudinal studies.[1-2] To gain insight in lifestyle changes and potential subsequent changes in productivity loss at work and sick leave, studies with a longer follow-up period with repeated measurements are desirable. It is plausible that an unhealthy lifestyle does not have an immediate but a delayed influence on indirect costs. A longer follow-up period is also required to get insight in the role of a healthy lifestyle in sustained labour participation.

Measurement of productivity loss at work

There is on-going discussion on how to measure productivity loss at work in a reliable and valid way.[3-4] The measurement of productivity loss at work relied on a subjective measure, namely the quantity question of the Quantity and Quality instrument (QQ), measuring the percentage of time loss while working.[5] Respondents were asked to indicate how much work they actually performed during regular hours on their most recent regular workday as compared with normal, using a 0-10 scale. In a previous study, it was found that the QQ was associated with objective work output among floor layers (r=0.48).[5] However, for floor layers it might be easier to estimate their work output than for workers in knowledge-based occupations. Since productivity indicators vary according to occupation and company, it is not possible to have a comparable objective indicator for productivity loss at work.[4] A disadvantage of the QQ is that productivity is assessed during the previous regular workday and therefore does not take into account expected fluctuations in productivity loss across workdays. Daily productivity assessments might be considered to take these daily fluctuations into account. However, as suggested by Reilly and colleagues (2004), the gain in precision should be balanced against the increase in cost and participant burden.[6] A somewhat longer recall period might give a more reliable estimate of productivity loss at work compared with a single day recall. The recall period for productivity loss at work should be no longer than one week, because a longer recall period reduces the recall accuracy and increases the effect of saliency.[6] Furthermore, another limitation using the QQ measure is the lack of a possibility to indicate an elevated productivity compared with the normal productivity level. Therefore, possible compensation mechanisms after a period with productivity loss cannot be identified

with the QQ. Knowledge of compensation mechanisms is of importance in the calculation of indirect costs as discussed later in this section.[7]

Determinants of reach and participation in workplace health promotion

In chapter 4, 6, 7, and 8, reach and sustained participation in workplace health promotion were evaluated. Differences between participants and non-participants were studied, determinants of sustained participation, and the use of the programme website was investigated.

Reach and selective participation

To assess characteristics of non-participants, a questionnaire, without reminders, was send to all employees not participating in the programme. The questionnaire was send out only once due to privacy regulations. Less than 25% of the non-participants responded to this questionnaire. There may thus be response bias among non-participants, what might hamper the generalization of the results. However, the results are in agreement with the findings in the systematic review presented in chapter 4.

Three of the participating organizations had a restricted maximum participation level, because they considered the study as a pilot before implementing health promotion activities to the total company population. This has led to an artificially lower participation level, while the mean participation is 43% after exclusion of the companies with a restricted participation. This is in line with the median reach of 33% as reported in the systematic review.

Since participation in the programme was voluntary, selection bias may occur. However, based on the systematic review (chapter 4) and the comparison of participants and non-participants in the cRCT (chapter 8), there are no indications for lifestyle- or health-related selection bias.

Website use

In line with previous studies we found a high attrition in programme use.[8-10] By sending monthly e-mail messages, in which questions were asked to participants, we intended to increase interaction and thereby increase exposure to the website content. When participants replied to the monthly e-mails, filled out self-monitors, or asked questions, new input for tailored e-mail content would be provided. However, due to a lack of interaction and self-monitor use, there was less input for interaction and the monthly e-mail messages were less tailored. This means that the intervention was not used as we had in mind, making the intervention of a less intensive character. From previous studies it is known that a more tailored feedback is more effective in behaviour change than providing general information.[11] However, because of the lack of new information, the e-mail messages were of a more general nature.

Cost-effectiveness of a long-term workplace health promotion programme containing a website component

Physical activity and fruit and vegetable intake were the primary outcomes in the cRCT investigating the effectiveness of a workplace health promotion programme (chapter 5, 9).

Measurement of physical activity and nutrition

For both physical activity and fruit and vegetable intake standardized questionnaires were used. The international physical activity questionnaires (IPAQ) is one of the most widely used questionnaires to assess physical activity, and is recommended as a viable method of monitoring population levels of physical activity globally for populations aged 15-69 years.[12-13] However, the IPAQ was not designed for the evaluation of interventions, and its sensitivity to detect changes over time is largely unknown. In an evaluation study, intervention effects were found on objective accelerometer data, but this effect was not found in the self-reported IPAQ data,[14] which may indeed indicate that the IPAQ is not sensitive enough to detect changes. In the literature over-reporting of physical activity with the IPAQ has been mentioned.[14-16] This is probably also the case in our study where more than 68% met the guideline of at least 30 minutes daily physical activity, even after excluding walking, as compared with the national percentage of 56% complying with the guideline, in which walking is included.[17] Fruit and vegetable intake was assessed with a short Dutch food frequency questionnaire.[18] In food frequency questionnaires over-reporting is also a concern.[19] Since the computer-tailored advice was based on over-reported levels of physical activity and fruit and vegetable intake, participants may have received incorrect advices suggesting they meet the recommended levels while they actually did not. However, we do not expect differences in self-reporting between the control and intervention group.

Using objective outcome measures for physical activity and fruit and vegetable intake has advantages over self-reported measures, because they are not prone to response bias. In addition, accelerometers provide information about the total amount, the frequency, the intensity, and the duration of physical activity in daily life.[20] However, the use of accelerometers and biomarkers is costly and logistically complex. Therefore, it could be questioned whether objective measures are suitable in large-scale epidemiologic research. Moreover, correlations between fruit and vegetable intake and concentrations of biomarkers (e.g. blood levels of carotenoids and vitamin c) are modest, because the biomarkers are also influenced by physiologic factors.[18] In addition, objective measures are also subject to substantial intra-individual variability,[21] and the optimal frequency and duration of measurement is unknown. When measuring physical activity with direct registration instruments the frequency and duration of periods of measurement should be representative for daily life.[22] Trost and colleagues (2005) recommend three to five full days of monitoring to reliably estimate physical activity. Another concern is the compliance with the monitoring protocol.[23] The use of a non-wear activity diary is therefore recommended.[24]

Economic evaluation

Issues concerning the measurement of productivity loss at work have been discussed previously in this chapter. In chapter 9 an economic evaluation is included, providing information on direct and indirect costs. In this economic evaluation the time lost due to productivity loss, was multiplied with the average wage. However, productivity loss does not always imply that the employer suffer those costs equal to the time lost. Compensation mechanisms were not taken into account in our study. Companies, occupations, and individuals differ in the way they handle absenteeism, with differences in costs as a consequence. Lost work due to sick leave may be compensated during normal work hours.[7] There may be colleagues who complete the work, or the individual might catch up the lost hours later. Such compensation mechanism decrease costs due to productivity loss. In the Netherlands the elasticity for annual labour time versus labour time productivity is assumed to be 0.8, i.e. with a time loss of 10% the productivity would decrease with 8%.[25] However, specific compensation mechanisms might influence the actual amount of productivity loss.

External validity

The external validity of a study refers to the generalizability of the study outcomes to a group outside the study population, for example another occupational group. The studies in this thesis were conducted in different occupational groups, with both white and blue-collar workers. Companies from different sectors participated in the study, increasing the external validity of the study results. As discussed before, self-selection can be a threat for the external validity, but there are no indications for major self-selection in initial participation based on lifestyle or health.

INTERPRETATION AND NEW INSIGHTS

Behaviour change programmes to influence indirect costs

Ill health and work conditions are related to both productivity loss at work and sick leave.[26-28] However, these factors were not addressed in our health promotion programme. The health promotion programme was primarily aimed at increasing fruit and vegetable intake and physical activity. At the start of the study, only little information was available on the relation between these lifestyle behaviours and productivity loss at work. In chapter 2 and chapter 3, we did not find consistent associations between insufficient physical activity, insufficient fruit and vegetable intake and indirect costs. However, obesity is related to both productivity loss at work and sick leave. This finding is not new, and in agreement with the literature.[1-2,26,29] Since obesity can be decreased by an increase in energy expenditure and/or a decrease in energy intake, behaviour change programmes can potentially influence indirect costs. In addition to obesity, smoking is also associated with indirect costs, and can be incorporated in

workplace behaviour change programmes. With population attributable fractions of lifestyle and obesity in sick leave and the higher levels of productivity loss at work above 10%, there are certainly important gains to be made by behaviour change programmes in the workplace setting.

Because of the strong relation between work-related factors and productivity loss at work and sick leave, it would be promising to integrate these factors in workplace health promotion activities. Higher participation levels and better outcomes were found in a programme integrating health promotion with occupation health and safety compared with a programme focusing on health promotion only.[30] Integrated workplace health promotion, focusing on both lifestyle and work factors, fits the concept of shared responsibility, in which both the employee and the employer are expected to take action to stay in good health. In addition, reducing strenuous work-related factors is also of importance to reduce socioeconomic differences in sick leave and productivity loss at work (chapter 3).

Moral considerations in workplace health promotion

Already in 1987 doubts on health promotion in the workplace setting were presented,[31] and the debate still continues. Our survey is one of the first studies whereby information on workers' moral considerations was collected. The importance of health promotion in the workplace setting was supported by both participants in the study as well as by non-participants. However, a fourth of the non-participants (26%), and 21% of the participants agreed with the statement that employer interference with their health is a violation of privacy. Although particularly older workers reported their concerns towards employer interference, they were more likely to start and sustain programme participation. Therefore, it is not likely that these moral considerations have a major impact on reach and programme effectiveness.

Internet-delivered workplace health promotion, how to improve participation?

It is not new that reach is limited and attrition is high in Internet-delivered health promotion programmes.[8-10,32] The workplace is regarded as a setting to reach large groups, making use of a natural social network.[33-34] However, limited participation was also a concern in our programme in the workplace setting. The systematic review on determinants of initial participation in workplace health promotion programmes showed that reach is higher in interventions consisting of multiple components (chapter 4).

In the studies in chapter 7 and 8 we did not only study website visit, but also the use of the specific intervention components. In focus groups it was mentioned that opportunities to ask questions to several professionals would attract them in a website aimed at increasing physical activity,[35] and experts suggested that the possibility to monitor progress through self-monitors could be a factor to increase programme use.[36] However, the use of both functionalities was limited in our study. This is a concern, since studies with higher programme

utilization tend to have better behaviour change outcomes.[8, 37] We did find that motivating monthly e-mail messages work as a prompt for programme participation. However, it is also clear that the e-mail messages in the first 12 months did not lead to sustained participation over the whole study period. In a recent qualitative systematic review it was indicated that peer and counsellor support, e-mail/phone contact with visitors, and website updates were related to better exposure.[38] Peer support and regular website updates are important points of improvement in the intervention we evaluated, and might lead to improvements in sustained programme use. However, since in previous Internet-delivered health promotion programmes at best small effects were reported,[39-40] no substantial improvements are expected with increased programme use.

In addition, a high-risk approach instead of or in addition to a general population approach might be beneficial for sustained participation. Chapter 8 shows an increased loss to follow-up among participants with an unhealthy lifestyle. This is a concerning finding, since particularly this group may benefit from health promotion activities, as is also shown in chapter 9, in which a beneficial intervention effect on fruit intake was found among those workers not meeting the recommended intake at baseline. By focusing on those groups who need it most, the intervention and all communication can be tailored to this high-risk group.

Internet-delivered workplace health promotion, what works?

The evaluated Internet-delivered programme showed no beneficial effects. In our study, a minimal effort intervention was evaluated, in which participants could visit the website at their own discretion, making it a less structured and intensive intervention. A systematic review on the effectiveness of worksite physical activity and nutrition programmes reported increased programme impact in more structured and intensive interventions.[41] Therefore, a minimal effort intervention is probably not the solution for long-term lifestyle effects.

Recently, a systematic review showed that two behaviour change techniques incorporated in the intervention, namely self-monitoring of behaviour outcome and the use of follow-up prompts, had small and non-significant effects on behaviour.[40] This were two important parts in the intervention evaluated in this thesis. In another recent meta-analysis it was concluded that workplace interventions aimed at physical activity and a healthy diet were more effective in reducing body weight when an environmental component (-1.5 kg) was included, compared with studies lacking an environmental component (-1.0 kg).[42] The intervention we evaluated did not contain an environmental component. With the ability to make use of natural social networks in the workplace setting, as well as shared environments there are opportunities to include more organizational and environmental aspects in behavioural interventions in the workplace setting as well.

Based on these recent studies and the results described in this thesis, an intensive, multicomponent intervention consisting of individual behaviour change programmes combined

with environmental changes, in which the Internet may function as a more supportive tool, might lead to increased participation and beneficial effects.

RECOMMENDATIONS

Recommendations for policy and practice

Health promotion activities in the workplace setting are recommended

A poor health, obesity and smoking have a major influence on productivity loss at work and sick leave. It was found that more than 10% of sick leave and the higher levels of productivity loss at work may be attributed to unhealthy lifestyle factors and obesity. Therefore, effective interventions aimed at these behaviours contribute to a more productive workforce.

To reduce productivity loss it is recommended to integrate health promotion activities with occupational health and safety.

In addition to a poor health, obesity and smoking do work-related factors also influence productivity loss at work and sick leave (chapter 2, 3). Therefore, it should be considered to integrate health promotion activities with policies and activities aimed at occupational health and safety.

Tailor interventions to those who need it most

Since there is a selective drop-out in workplace health promotion, it is important to design an intervention with special attention to reach those workers who need it most, and to challenge them to keep participating. Since a lower socioeconomic status is related to unhealthy behaviours, efforts should be made in reaching this group in particular.

More intensive programmes for behaviour change

Frequent e-mail messages work as a prompt to visit a website focused on behaviour change. However, more is needed to keep visitors attracted to a behaviour change programme and to elicit beneficial intervention effects. According the current literature structured and intensive programmes are required to provide effective interventions.

It is recommended to evaluate the reach, use and effects of health promotion activities

In companies, numerous health promotion activities are offered without a proper evaluation and, thus, without an idea about reach, uptake, and effectiveness. It is advisable to get insight in the reach, as well as on the use of such activities, and to evaluate the effects.

Recommendations for future research

Study the influence of moral considerations in workplace health promotion on participation

The importance of health promotion in the workplace setting was supported by both participants in the study as well as by non-participants. However, there are concerns about violation of privacy due to employer interference with their health. It would be interesting to investigate in future research the role of moral considerations in participation in workplace health promotion. In addition, knowledge on the underlying reasons why workers have moral objections regarding workplace health promotion is needed in order to determine whether moral objections can and need to be influenced.

Study the role of the work environment on participation in workplace health promotion

In this thesis differences between non-participants and participants in workplace health promotion were studied. However, the information on physical and social barriers and facilitators to participate in workplace health promotion are unknown. It is recommended to investigate whether and how the work environment influences participation in workplace health promotion.

Study intervention effectiveness in addition to efficacy

Numerous studies investigate the efficacy of workplace health promotion programmes. However, there is poor insight in determinants of reach and sustained participation in health promotion activities, and thus in the effectiveness of the intervention across different populations. Studies evaluating the efficacy of health promotion activities should include information on reach and characteristics of participants and non-participants to assess whether those individuals who need it most are reached. Furthermore, thorough process evaluations might provide insight into which programme content might enhance participation in health promotion programmes.

Study occupational physical activity

The short version of the IPAQ does not specifically ask for physical activity at work and for differences in pace or intensity. There are questionnaires specifically designed to assess occupational physical activity. However, the validity of these questionnaires is poor compared with objective measures.[43] Workers with a long history of physical work are less likely to engage in leisure-time physical activity.[44] Since obesity is more prevalent in physically demanding jobs,[45] it could be questioned whether the intensity of occupational physical activity is enough to be health-enhancing and could be regarded as a replacement of leisure time physical activity in these occupations. In the current study, occupational physical activity was not specifically addressed. To get more insight in the role of occupational physical activity, studies using objective measures of physical activity are needed.

Insight in the long-term effects of behaviour change programmes

The evaluated intervention did not succeed to influence physical activity level and diet. There are indications that intensive and structured workplace health promotion programmes, including an environmental component, can promote healthy behaviours. However, there is still a lack of high-quality studies providing information on long-term benefits of behaviour change interventions. To gain insight in the role of lifestyle on sustained labour participation, studies with a long follow-up period and repeated measurements are needed.

GENERAL CONCLUSION

Poor health is an important risk factor of productivity loss at work and sick leave. Unhealthy lifestyle factors, particularly smoking and obesity, and strenuous working conditions play a role in productivity loss at work and sick leave. Physical activity and fruit and vegetable intake, the primary outcomes of the intervention study, were no important factors for productivity loss at work and sick leave. There were no differences in lifestyle and health between participants and non-participants in the workplace health promotion programme. Although older employees were more likely to have resistance against employer interference with their health, they were more likely to start to participate and to sustain in the programme. The use of the intervention programme was limited, with only a minority of the participants using the specific intervention components. However, monthly e-mail messages lead to increased website visit, but participants with an unhealthy lifestyle were less likely to stay attracted to the programme. A long-term minimal effort Internet-delivered intervention in the workplace setting showed no additional benefits in effects or costs. The programme in its current form is therefore not recommended for implementation.

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Summary/Samenvatting

SUMMARY

An unhealthy lifestyle is an important determinant of poor health, and might also be a determinant of productivity loss among workers. Therefore, numerous health promotion programmes are offered in the workplace setting. However, there is a lack of knowledge on the association between lifestyle and productivity loss, as well as on participation in and long-term effectiveness of workplace health promotion. Therefore, this thesis addressed the following objectives:

1) To study the influence of unhealthy lifestyle, poor health, and strenuous working conditions on productivity loss at work and sick leave;
2) To identify determinants of reach and participation in workplace health promotion;
3) To study the cost-effectiveness of a long-term workplace health promotion programme containing a website component.

This thesis presents a series of studies addressing these objectives (chapter 2-9). Data in most of the studies, except chapter 2 and chapter 4, were derived from a cluster randomized controlled trial (cRCT). The design of this trial is discussed in **chapter 5**, presenting a study protocol for the evaluation of a two-year health promotion programme. The effectiveness was evaluated among employees (n=924) from six companies receiving a physical health check and personalized website. Participants in the intervention group had access to several additional website functionalities: a) more extensive computer-tailored advice including action-oriented feedback, b) possibility to use self-monitors to track their own behaviour and body weight throughout the two-year study period, c) opportunity to ask questions to several health professionals. In addition, they received monthly e-mail messages during the first 12 months. Follow-up measurements took place 12 and 24 months after baseline.

The influence of unhealthy lifestyle, poor health, and strenuous working conditions on productivity loss at work and sick leave

Chapter 2 presents a cross-sectional study investigating the role of lifestyle factors on productivity loss at work and sick leave among 10,624 workers from 49 companies. The presence of diseases was strongly associated with both productivity loss at work and sick leave (ORs from 1.31 to 2.91). Obesity was associated with the presence of sick leave (OR=1.25), with more sick leave days (25+ days: OR=1.55), as well as with a higher degree of productivity loss at work (OR=1.29). In addition, smoking was associated with sick leave (OR=1.17) and with a higher degree of productivity loss at work (OR=1.45). More than 10% of sick leave and the higher level of productivity loss at work may be attributed to unhealthy lifestyle factors and obesity.

Chapter 3 presents a study among cRCT participants (n=647) examining whether lifestyle, health, and work conditions could explain educational differences in productivity loss at work

and sick leave. Productivity loss at work and sick leave were more apparent among employees with a low educational level, with an odds ratio of 1.56 for the more severe category of productivity loss at work and 1.90 for 10 or more days with sick leave. A 'less than good health' is the most important contributor to the presence of productivity loss at work and sick leave, with odds ratios varying from 1.90 to 6.51. However, educational differences could hardly be attributed to differences in health. Poor psychosocial work conditions were stronger associated with both productivity loss at work and sick leave than unhealthy lifestyle behaviours. Work-related (from OR=1.90 to OR=1.75) and lifestyle factors (from OR=1.90 to OR=1.74) did attenuate the association between low education and sick leave.

Determinants of reach and participation in workplace health promotion

In **chapter 4**, a systematic review, 23 studies were included on workplace health promotion programmes aimed at physical activity and a healthy diet. Participation levels varied from 10% to 64%, with a median of 33% (95% CI 25–42%). In general, female workers had a higher participation than male workers (OR=1.67). For other demographic, health- and work-related characteristics no consistent effect on participation was found. Pooling of studies showed a higher participation level when the programme consisted of multiple components.

In **chapter 6** moral considerations regarding health promotion offered by employers were investigated, as well as differences concerning these considerations between the participants (n=513) and non-participants (n=203) in the cRCT. More than a fourth of the non-participants (26%), and 21% of the participants thought that employer interference with their health is a violation of privacy. There are, especially among older workers, concerns about the role of the employer in workplace health promotion and the possible violation of privacy. However, most employees thought it is good that an employer tries to improve employees' health.

Chapter 7 presents the use of the website in the first months of the cRCT. Female participants were more likely to use the website to obtain personalized advice for behaviour change (OR=2.36). There was limited use of the specific intervention components, with only a minority of the participants who read their personalized advices, filled out self-monitors to track their behaviours, or asked questions. Individuals in the intervention group visited the website more often compared with participants in the control group during the first study months (OR 3.96). In this period, the intervention group received monthly e-mail messages, which functioned as a prompt for website visit. This was confirmed in **chapter 8**, in which determinants of initial and sustained participation in the cRCT were investigated. Older employees were more likely to start participating in the programme as well as to sustain. Lifestyle and health indicators were not related to initial participation, but did play a role in sustained participation as well as in visiting the website throughout the study period. Participants with an unhealthy lifestyle were less likely to sustain their participation and to use the website. In addition, workers with a low intention to change their physical activity

level were less likely to start, but once participating they were more likely to sustain and to use the website.

Cost-effectiveness of a long-term workplace health promotion programme

Chapter 9 presents the cRCT evaluating the intervention described in chapter 5. The study showed no additional intervention effects on self-reported physical activity and fruit and vegetable intake. In addition, the programme had no beneficial effects on self-perceived health, body mass index, cholesterol level, blood pressure, and cardio-respiratory fitness. Focusing on those participants not meeting the recommendations at baseline, a beneficial intervention effect was found for fruit intake at one-year follow-up (OR=2.03). The intervention costs were €7 per participant in the first 12 months and €5 in the subsequent 12 months higher compared with the standard programme. There were no differences in direct costs due to the use of health care resources nor in indirect costs due to productivity loss at work and sick leave. The direct costs were lower than the indirect costs, with a mean of respectively €206 and €5139 per participant over the two-year period.

In **chapter 10**, the main findings of this thesis are presented. In addition, methodological issues are discussed, new insights are described, and recommendations for policy and practice, and for research are presented. Finally, the following conclusions are formulated. Poor health is an important risk factor of productivity loss at work and sick leave. Unhealthy lifestyle factors, particularly smoking and obesity, and strenuous working conditions play a role in productivity loss at work and sick leave. Physical activity and fruit and vegetable intake, the primary outcomes of the intervention study, were not important factors for productivity loss at work and sick leave. There were no differences in lifestyle and health between participants and non-participants in the workplace health promotion programme. Although older employees were more likely to have resistance against employer interference with their health, they were more likely to start to participate and to sustain in the programme. The use of the intervention programme was limited, with only a minority of the participants using the specific intervention components. However, monthly e-mail messages have led to increased website visit, but participants with an unhealthy lifestyle were less likely to stay attracted to the programme. A long-term minimal effort Internet-delivered intervention in the workplace setting showed no additional benefits in effects or costs. The programme in its current form is therefore not recommended for implementation.

SAMENVATTING

Een ongezonde leefstijl is een belangrijke determinant van een slechte gezondheid, en is mogelijk ook van invloed op de arbeidsproductiviteit van werknemers. Dit is voor bedrijven een aanleiding om activiteiten ter bevordering van een gezonde leefstijl aan hun werknemers aan te bieden. Er is echter een gebrek aan kennis over de relatie tussen een ongezonde leefstijl en productiviteitsverlies. Ook is er weinig bekend over welke werknemers worden bereikt met programma's voor gezondheidsbevordering op de werkplek en de langetermijneffecten van deze programma's. Daarom zijn in dit proefschrift onderstaande doelen geformuleerd:

1) Bestuderen van de invloed van een ongezonde leefstijl, verminderde gezondheid, en ongunstige werkomstandigheden op productiviteitsverlies en ziekteverzuim;
2) Inzicht krijgen in de determinanten van bereik en deelname aan gezondheidsbevordering op het werk;
3) Onderzoeken van de kosteneffectiviteit van een langdurig programma voor gezondheidsbevordering op de werkplek.

Dit proefschrift presenteert verschillende studies gericht op bovenstaande doelen (hoofdstukken 2-9). De gegevens in de meeste studies, met uitzondering van hoofdstuk 2 en hoofdstuk 4, zijn afkomstig uit een cluster randomized controlled trial (cRCT). In **hoofdstuk 5** wordt het studieprotocol voor deze cRCT met de evaluatie van een twee jaar durend programma ter bevordering van de gezondheid van werknemers beschreven. De effectiviteit werd geëvalueerd bij werknemers (n=924) van zes bedrijven die deelnamen aan een fysieke gezondheidsmeting en toegang hadden tot een persoonlijke website. Deelnemers in de interventiegroep hadden toegang tot verschillende extra mogelijkheden op deze website: a) uitgebreid advies-op-maat advies met actiegeoriënteerde feedback, b) mogelijkheid om het eigen gedrag en lichaamsgewicht gedurende twee jaar te monitoren, en c) mogelijkheid om vragen te stellen aan verschillende gezondheidsprofessionals. Daarnaast ontvingen zij tijdens de eerste 12 maanden maandelijks motiverende e-mailberichten. Follow-up metingen vonden 12 en 24 maanden na de beginmeting plaats.

De invloed van een ongezonde leefstijl, verminderde gezondheid, en ongunstige werkomstandigheden op productiviteitsverlies en ziekteverzuim

Hoofdstuk 2 beschrijft een cross-sectionele studie waarin de rol van leefstijlfactoren op productiviteitsverlies en ziekteverzuim wordt onderzocht onder 10.624 werknemers van 49 bedrijven. De aanwezigheid van ziekten bleek sterk geassocieerd met zowel productiviteitsverlies als ziekteverzuim (odds ratios (ORs) tussen 1,31 en 2,91). Obesitas bleek geassocieerd met de aanwezigheid van ziekteverzuim (OR 1,25), meer dagen ziekteverzuim (≥25 dagen: OR=1,55), en met een hogere mate van productiviteitsverlies (OR=1,29). Daarnaast bleek roken geassocieerd met ziekteverzuim (OR=1,17) en met een hogere mate van productivi-

teitsverlies (OR=1,45). Meer dan 10% van het ziekteverzuim en een hogere mate van productiviteitsverlies zou kunnen worden toegeschreven aan een ongezonde leefstijl en obesitas.

In **Hoofdstuk 3** wordt onderzocht of er sociaal-economische verschillen zijn in productiviteitsverlies en ziekteverzuim onder de deelnemers van de cRCT (n=647), en in hoeverre deze verschillen kunnen worden toegewezen aan leefstijl, gezondheid en werkomstandigheden. Productiviteitsverlies en ziekteverzuim kwamen meer voor bij mensen met een laag opleidingsniveau, met een odds ratio van OR=1,56 bij een hogere mate van productiviteitsverlies en OR=1,90 voor 10 of meer dagen ziekteverzuim. Een verminderde gezondheid bleek significant geassocieerd met productiviteitsverlies en ziekteverzuim (odds ratios variërend van OR=1,90 tot en met OR=6,51). In vergelijking met een ongezonde leefstijl, bleken ongunstige psychosociale werkomstandigheden sterker geassocieerd met zowel productiviteitsverlies als ziekteverzuim. De sociaal-economische verschillen in productiviteitsverlies en ziekteverzuim kunnen nauwelijks worden toegeschreven aan verschillen in gezondheid. Werk-gerelateerde en leefstijlfactoren blijken wel een rol te spelen in de relatie tussen opleidingsniveau en ziekteverzuim.

Determinanten van bereik en deelname aan programma's voor gezondheidsbevordering op het werk

Hoofstuk 4 beschrijft een systematische review naar deelname aan gezondheidsprogramma's op de werkplek. In totaal werden 23 studies geïncludeerd over programma's gericht op lichamelijke activiteit en gezonde voeding. Deelname aan deze programma's varieerde tussen 10% en 64%, met een mediane deelname van 33% (95% betrouwbaarheidsinterval 25-42%). Over het algemeen is de deelname onder vrouwen hoger dan onder mannen (OR=1,67). Voor andere demografische, gezondheid- en werkgerelateerde kenmerken werden geen consistente effecten op deelname gevonden. Bij programma's bestaande uit meerdere componenten werd een hogere deelname gevonden dan bij programma's waarbij uitsluitend gezondheidsvoorlichting of sportfaciliteiten werden aangeboden.

In **hoofdstuk 6** werden morele overwegingen in het kader van gezondheidsbevordering bij bedrijven onderzocht. Hierbij werd ook onderzocht of deelnemers (n=513) en niet-deelnemers (n=203) in de cRCT verschillende morele overwegingen hadden ten aanzien van gezondheidsbevordering op de werkplek. Meer dan een kwart van de niet-deelnemers (26%), en 21% van de deelnemers vonden bemoeienis van de werkgever met hun gezondheid privacyschending. Er is, voornamelijk onder oudere werknemers, bezorgdheid over de rol van de werkgever in gezondheidsbevordering op het werk. De meeste werknemers vinden het echter goed dat een werkgever probeert de gezondheid van haar werknemers te verbeteren.

Hoofdstuk 7 beschrijft het gebruik van de interventiewebsite gedurende de eerste maanden van de cRCT. Meer vrouwen dan mannen gebruikten de website voor persoonlijk advies gericht op leefstijlverbetering (OR=2,36). Het gebruik van de specifieke interventiecompo-

nenten was beperkt, met slechts een minderheid van de deelnemers die daadwerkelijk de persoonlijke adviezen lazen, het gedrag monitorden, of vragen aan diverse professionals stelden. Gedurende de eerste maanden van de studie bezochten relatief meer deelnemers in de interventiegroep dan in de controlegroep de persoonlijke website (OR=3,96). In deze periode ontving de interventiegroep maandelijkse e-mailberichten, die als een prikkel werkten om de website te bezoeken.

Deze bevinding werd bevestigd in **hoofdstuk 8**, waarin determinanten van initiële en blijvende deelname in de cRCT werden onderzocht. Uit deze studie bleek ook dat oudere werknemers eerder geneigd waren te starten en te blijven deelnemen aan het programma dan jongere werknemers. Leefstijl en gezondheidsindicatoren bleken niet gerelateerd aan initiële deelname, maar speelden wel een rol in het blijven bezoeken van de website gedurende de studieperiode. In vergelijking met deelnemers met een gezonde leefstijl bleven relatief minder deelnemers met een ongezonde leefstijl de website gebruiken. Daarnaast waren werknemers met een lage intentie om meer te gaan bewegen minder geneigd met het programma te startten, maar bleken bij uiteindelijke deelname wel meer geneigd te blijven deelnemen en de website te gebruiken dan deelnemers met een hoge intentie om meer te gaan bewegen.

Kosteneffectiviteit van een langdurig programma voor gezondheidsbevordering op de werkplek

Hoofdstuk 9 presenteert de cRCT waarin de interventie, zoals beschreven in hoofdstuk 5, wordt geëvalueerd. Deze studie liet geen significante verbetering zien in zelfgerapporteerde lichamelijke activiteit en groente- en fruitconsumptie na deelname aan de interventie in vergelijking met een referentiegroep. Daarnaast bleek het programma niet tot verbeteringen te leiden in zelfgerapporteerde gezondheid, body mass index, cholesterol, bloeddruk, en cardiovasculaire fitheid. Bij de deelnemers die bij de start van het programma niet aan de aanbevelingen voor een gezonde leefstijl voldeden, werd een positief interventie-effect gevonden voor fruitconsumptie (OR=2,03). De interventiekosten waren, in vergelijking met het standaard programma, per deelnemer €7 hoger in de eerste 12 maanden, en €5 per deelnemer hoger in de daaropvolgende 12 maanden. Er waren geen verschillen in directe kosten als gevolg van het gebruik van gezondheidszorgvoorzieningen noch in indirecte kosten door productiviteitsverlies en ziekteverzuim. De directe kosten van de interventie waren lager dan de indirecte kosten, respectievelijk €206 en €5139 per deelnemer over de tweejarige studieperiode.

In **hoofdstuk 10** worden de belangrijkste bevindingen uit de studies beschreven. Hierin worden ook methodologische kwesties bediscussieerd, nieuwe inzichten beschreven en aanbevelingen gedaan voor beleid, praktijk en toekomstig onderzoek. Ten slotte zijn onderstaande conclusies geformuleerd.

Een verminderde gezondheid is een belangrijke risicofactor voor productiviteitsverlies en ziekteverzuim. Een ongezonde leefstijl, waaronder met name roken en obesitas, en ongunstige werkomstandigheden spelen een rol in productiviteitsverlies en ziekteverzuim. Lichamelijke activiteit en groente- en fruitconsumptie (de primaire uitkomsten van de interventiestudie) waren geen belangrijke determinanten van productiviteitsverlies en ziekteverzuim. Er was geen verschil in leefstijl en gezondheid tussen deelnemers en niet-deelnemers in het programma ter bevordering van de gezondheid bij bedrijven. Hoewel oudere werknemers meer weerstand hadden tegen bemoeienis van de werkgever met hun gezondheid, waren ze eerder geneigd met het programma te startten en bleven ze ook meer deelnemen. Het gebruik van het interventieprogramma was beperkt, met een minderheid van de deelnemers die gebruik maakte van de specifieke interventiecomponenten. De maandelijkse e-mailberichten naar de interventiegroep leidden tot een verhoogd bezoek van de website, maar deelnemers met een ongezonde leefstijl waren minder geneigd om op de website terug te komen en te blijven deelnemen aan de studie. Het interventieprogramma bij werknemers leidde niet tot leefstijlverbeteringen of kostenbesparing. Het programma in zijn huidige vorm wordt daarom niet aanbevolen voor implementatie in de praktijk.

Dankwoord
Curriculum Vitae
List of publications
PhD Portfolio

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CURRICULUM VITAE

Suzan Joanna Wilhelmina Robroek was born, on 18th December 1982, and raised in Heerlen, the Netherlands. After graduating from secondary school at Sintermeertencollege, in 2001, she started studying Human Movement Sciences at the VU University in Amsterdam. She obtained her Master of Science degree in 2005 with a major in health care. Subsequently, she worked as a junior epidemiologist at the community health service of Kennemerland in Haarlem. In 2007 she started with the PhD project resulting in this thesis on workplace health promotion at the Department of Public Health of the Erasmus MC in Rotterdam. Meanwhile, she completed the Master of Science programme at the Netherlands Institute for Health Sciences (Nihes), and obtained her Master of Science in health sciences, specialisation epidemiology, in August 2010. She is currently working as a postdoctoral researcher at the Department of Public Health of the Erasmus MC in Rotterdam, the Netherlands.

Suzan Joanna Wilhelmina Robroek is geboren, op 18 december 1982, en opgegroeid in Heerlen. In 2001 behaalde ze haar VWO diploma aan het Sintermeertencollege te Heerlen. Vervolgens startte ze met de studie bewegingswetenschappen aan de Vrije Universiteit in Amsterdam. In 2005 studeerde ze af, met als afstudeerrichting 'gezondheidszorg'. Na haar afstuderen werkte zij in de functie van epidemioloog bij de GGD Kennemerland in Haarlem. Vanaf 2007 is zij als onderzoeker verbonden aan de afdeling Maatschappelijke Gezondheidszorg van het Erasmus MC in Rotterdam en voerde het promotieonderzoek uit dat resulteerde in dit proefschrift. In deze periode volgde ze de opleiding Epidemiologie bij de Netherlands Institute for Health Sciences (Nihes), die ze in augustus 2010 met een Master of Science afrondde. Op dit moment is ze werkzaam als postdoctoraal onderzoeker aan de afdeling Maatschappelijke Gezondheidszorg van het Erasmus MC in Rotterdam.

LIST OF PUBLICATIONS

2011

Robroek SJW, Van den Berg TIJ, Plat JF, Burdorf A. The role of obesity and lifestyle behaviours in a productive workforce. *Occup Environ Med* 2011;68:134-9

Robroek SJW, Van de Vathorst S, Hilhorst MT, Burdorf A. Moral issues in workplace health promotion. *Int Arch Occup Environ Health* [Published online first: 28 June 2011]

2010

Robroek SJW, Brouwer W, Lindeboom D, Oenema A, Burdorf A. Demographic, behavioral, and psychosocial correlates of using the website component of a worksite physical activity and healthy nutrition promotion program: a longitudinal study. *J Med Internet Res* 2010;12:e44.

Van den Berg TI, Robroek SJ, Plat JF, Koopmanschap MA, Burdorf A. The importance of job control for workers with decreased work ability to remain productive at work. *Int Arch Occup Environ Health* [Published online first: 16 October 2010]

2009

Robroek SJW, Van Lenthe FJ, Van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review. *Int J Behav Nutr Phys Act* 2009;6:26.

2007

Robroek SJW, Bredt FJ, Burdorf A. The (cost-)effectiveness of an individually tailored long-term worksite health promotion programme on physical activity and nutrition: design of a pragmatic cluster randomized controlled trial. *BMC Public Health* 2007;7:259.

Submitted papers:

Robroek SJW, van Lenthe FJ, Burdorf A. The role of lifestyle, health, and work in educational inequalities in sick leave and productivity loss at work.

Robroek SJW, Lindeboom DEM, Burdorf A. Initial and sustained participation in an Internet-delivered long-term worksite health promotion program on physical activity and nutrition.

Robroek SJW, Polinder S, Bredt FJ, Burdorf A. Cost-effectiveness of a long-term Internet-delivered worksite health promotion program on physical activity and nutrition: a cluster randomized controlled trial.

PHD PORTFOLIO SUMMARY

Summary of PhD training and teaching activities

PhD student: Suzan JW Robroek
Erasmus MC, Department of Public Health

PhD period: 2007-2011
Promotor: Prof.dr.ir. A. Burdorf

	Year	Workload (ECTS)
1. PhD training		
General academic skills		
Scientific English writing for PhD students, Erasmus MC, Rotterdam	2010	4.0
Research skills		
Master of Science in Public Health, specialization Epidemiology, Netherlands Institute for Health Sciences (Nihes), Rotterdam	2008-2010	70.0
Scientific presentations		
International Congress on Physical Activity and Public Health, Amsterdam - Determinants of participation in worksite health promotion programme	2008	0.6
Research meeting, Department of Public Health, Erasmus MC, Rotterdam - Participation in worksite health promotion	2009	0.6
Annual conference of the International Society for Behavioral Nutrition and Physical Activity, Lisbon, Portugal - Do healthy workers participate more in workplace health promotion?	2009	0.6
Werkgroep Epidemiologisch Onderzoek Nederland, Amsterdam - Determinanten van deelname aan gezondheidsbevordering op de werkplek: Een systematische review *(poster)*	2009	0.4
Research meeting, Department of Public Health, Erasmus MC, Rotterdam - The role of obesity and lifestyle behaviors in a productive workforce	2010	0.6
International Conference on Epidemiology in Occupational Health, Taipei, Taiwan - Productivity loss and sick leave: associations with lifestyle, health factors, and work demands	2010	0.6
Annual conference of the International Society for Behavioral Nutrition and Physical Activity, Minneapolis, United States - Demographic, behavioral and psychosocial correlates of using the website-component of a worksite physical activity and healthy nutrition promotion program - Determinants of loss to follow-up in a worksite health promotion program *(poster)*	2010	1.0
Werkgroep Epidemiologisch Onderzoek Nederland, IJmuiden - The role of lifestyle, health, and work in educational inequalities in sick leave and productivity loss at work *(poster)*	2011	0.4

	Year	Workload (ECTS)
Conferences		
International Congress on Physical Activity and Public Health, Amsterdam	2008	0.6
Annual conference of the International Society for Behavioral Nutrition and Physical Activity, Lisbon, Portugal	2009	0.6
Werkgroep Epidemiologisch Onderzoek Nederland, Amsterdam	2009	0.4
International Conference on Epidemiology in Occupational Health, Taipei, Taiwan	2010	0.6
Annual conference of the International Society for Behavioral Nutrition and Physical Activity, Minneapolis, United States	2010	0.6
Werkgroep Epidemiologisch Onderzoek Nederland, IJmuiden	2011	0.4
Seminars/symposia		
Attending seminars of the Department of Public Health	2007-2011	3.6
2e congres gezondheidsmanagement: Bedrijf in Beweging, Amersfoort	2007	0.2
Bewegen werkt, Oegstgeest	2009	0.2
Beweging in werk, Woudenberg	2009	0.2
Bevordering gezonde leefstijl werkt?, Amsterdam	2011	0.2
6e Leuftinklezing: De Digitale Droom, Woudenberg	2011	0.1
2. Teaching activities		
Supervising Study group Work and Health Curriculum medical students, 4th year Erasmus MC, Rotterdam, The Netherlands	2010	1.4